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LEFFMANN MEMORIAL NUMBER

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THE AMERICAN
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DR. HENRY LEFFMANN

Life Story

WHEN ASKED to submit a few of the outstanding facts which should form the basis of his life's story, Dr. Leffmann once replied, with his characteristic humor and a twinkle of merriment in his eye—for he was an inimitable teller of tales, always welcomed as a dinner guest or at a gathering of what in these days is sometimes called "the intelligentsia"—"I would like my biography to begin as follows: 'Henry Leffmann was born on September 9, 1847, in Philadelphia. His ancestry on his father's side is partly Russian Jewish; on his mother's side, partly Welsh Quaker. He was educated in the public schools, completing the course of B. A. at Central High School, Philadelphia, and subsequently receiving the degree of M. A. *honoris causa.*'" He then added: "In these days of genetics and eugenics it is worth while to show that a mongrel may have some merit."

This might be called unassuming pride, but it is characteristic of the man who has taught more physicians and teachers, compiled more reference books and textbooks, and written more original articles and reviews than any chemist in America today.

A practicing analyst for more than fifty years, he ran the gamut of every kind of experience and position, from laboratory helper in the laboratory of a famous Philadelphia chemist of a half century ago, Dr. Charles M. Cresson, through the responsibilities of chemist to the offices of coroner and district attorney, respectively, and chemist to the Dairy and Food Commission of Pennsylvania, to one of the most noted analytical consultants of his community.

Graduating in medicine in 1869, he taught chemistry in Jefferson Medical College and in the Central High School; also toxicology in

Jefferson College for several years. Subsequently he became professor of chemistry in the Pennsylvania College of Dental Surgery, in Wagner Free Institute of Science, and in the Woman's Medical College of Pennsylvania, occupying the last position for thirty years.

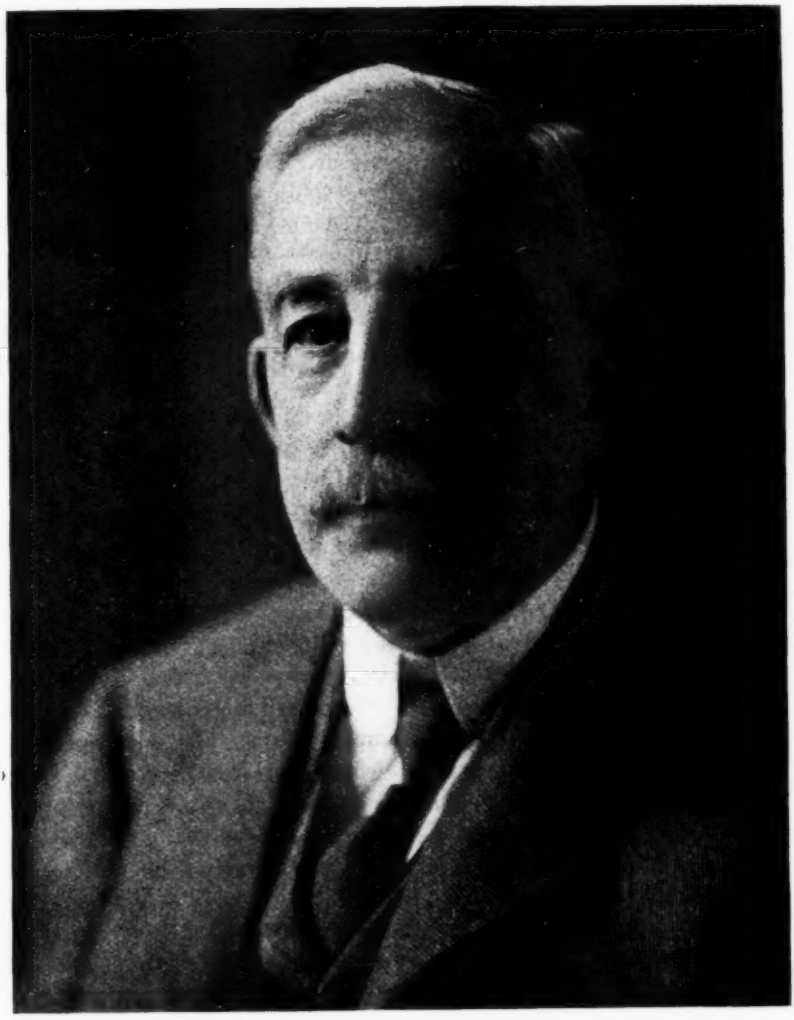
He was port physician in Philadelphia from 1884 to 1887, and again in 1891 to 1892, and was active in the work of the Philadelphia County Medical Society for many years, holding the offices of secretary and of president in that important organization. He was long active in the work of the Engineers' Club of Philadelphia, and was president of this body for one term. This is not only a social organization, as its name might indicate, but is one of the leading engineering societies of the country.

For many years he was actively identified with the work of the Franklin Institute and was of great assistance in the development of its valuable journal, to which he contributed many valuable book reviews. At the time of the recent centenary of that famous society, he contributed largely to its success by collecting the material for the souvenir book of the occasion.

He was actively connected with the Wagner Free Institute of Science for more than fifty years and also served as chairman of the board of trustees, and for many years edited and published a quarterly bulletin for this unique organization which has attracted so many noted scientists to its lecturing staff and has stimulated so much popular interest in scientific subjects.

For the last ten years of his life he was lecturer on research in in the Philadelphia College of Pharmacy and Science and special contributor of editorials and book reviews to the AMERICAN JOURNAL OF PHARMACY, which has been published for over a century by the College.

During his association with food control work in Pennsylvania, Dr. Leffmann and his associate, Dr. William Beam, later of the Burroughs Wellcome research staff at Khartoum developed the glycerol-soda process for determining the volatile fat acids of butter and other fats. For some incomprehensible reason this valuable method was at first condemned and then ignored by American official analysts. It was first officially adopted in Germany and later adopted in the United States. Dr. Leffmann was accustomed to refer humorously to this episode as a "conspiracy of silence," and it would seem as though it had been required to bear the stamp "Made in Germany" before it gained American approval.



Henry Leffmann

Dr. Leffmann's contributions to chemical literature have been extensive, comprising papers on various subjects, mostly analytical, and textbooks on chemistry and manuals of analysis. Among the latter his "Water Analysis" and "Milk Analysis" have gone through a number of editions. "Select Methods in Food Analysis," written in association with Dr. Beam, was very favorably received and widely used. Several of the volumes of different editions of "Allen's Commercial Organic Analysis" were issued under his editorial supervision.

Outside of strictly scientific subjects he has written on New Testament topics: also a booklet "The States-Rights Fetish" and another entitled "About Dickens," being essays on themes suggested by the novels of that author. This work is now out of print and is being sought for by collectors of Dickensiana, at prices much above the original price of publication.

As a chemico-legal and medico-legal expert he is a shining exemplar of all that a scientific expert should be in the matter of impartial testimony of facts and opinions deduced therefrom. Newspapers editors and reports eagerly sought his opinion upon scientific topics of popular interest, for he had a simplicity of style and a clarity of diction which were especially desirable in news articles.

During the latter days of his life, he remained active and alert mentally and physically, and spent much of his time experimenting with color and photomicrography, which were his especial hobbies. He carried on extensive correspondence with scientists in other lands, particularly botanists, with whom he exchanged herbarium specimens. As a lecturer or talker, either to visible or invisible audiences, he was much in demand. His encyclopedic memory and apt use of quotations made him a brilliant conversionalist.

Dr. Leffmann had a liking for young men, especially those with a scientific bent, and several times took a young chemist into his laboratory with him, helping him, giving him the prestige of association with him, until the young man was able to stand alone, then relinquishing the business to him, as was the case with the writer of this sketch.

The respect and admiration of his friends and associates ever remained with him, and in Philadelphia, scientific circles counted a rare privilege to know him and be associated with him. For some unaccountable reason he never connected himself actively with asso-

ciation affairs, although he was a member of many scientific organizations of America and Europe.

Notwithstanding his lifelong tendency to hold himself aloof from his fellow workers outside of his own community, few men labored more zealously to give chemistry a professional standing, or with greater success, than did Henry Leffmann, the Nestor of Philadelphia physicians and chemists.

After a busy career, over fifty years of which were dedicated to an intensive, intelligent serving of his fellow man, death came to the Doctor on Christmas Day, 1930.

CHARLES H. LAWALL.

IN MEMORIAM

Henry Leffmann—1847-1930

Henry Leffmann is dead!

Unbelievably silent is the voice—strangely inactive is the mind of one—who, over the trail of many a decade, served the world in which he worked, served it with intelligence—with diligence—and with honor. His had been an unusual lite, marked with an extraordinary fullness of service.

His versatile brain carried him to diversified fields of endeavor—and left him useful and comfortable wherever it chanced to convey him.

Afield, he was quite at home with all of God's green children—flower and fern, and tuft and tree—rocks he understood—knew them with a rare intimacy—sod and soil, and many waters,—all of Nature—he surveyed with a keen delight and yet a keener understanding.

Long had he lingered—and deep his draughts at the Pierian spring of literature. In all our life we have never known one whose command of memory was quite so brilliant.

Out of the vastnesses of his mind he could summon accurately and at an instant's notice, words sweet-sung by Shakespeare—or a passage spun by Goethe.

Else it might have been a fragment of the song of Solomon—or a seldom quoted bit of Plato's wit—

Anywhere—everywhere in the world's literature was his mental camping place.

And then how helpful a spirit he owned. Today in the scientific eminences of America are many men and women who owe their start and their urge to Henry Leffmann's guidance. To the end he was a mentor—a directionist—who wisely started youngsters toward the right and into the light.

His own life, he arranged in such a way that earlier than is given to most men to retire from active practice, he was enabled, in comfort, to dedicate his life to a calm, considerate scheme of service.

One who serves Science for nearly three score years and ten—and serves it so intimately as Dr. Leffmann did—lives through a magnitude of mutations.

"The old order*s* chang*ed*—yielding place to new—and God fulfilled himself in many ways"—during the great man's spell of life—

yet for it all there was no lagging of spirit in him—no grievances with the present nor a silly, senile love for the what-had-gone. New days were the good days for him—and to the last he held to a fine fluidity of mind and heart—and *knew* that the world was progressing.

Tolerant—friendly—familiar with art, music, literature, history, science, religion and ethics—a successful teacher—known the world over for his researches in chemistry—and for his contributions to the scientific literature—Henry Leffmann has left behind him a record seldom achieved by any one man.

In accord with his last wish—it was a friendly dust that found its way—the other morning—back to its mother dust in a sylvan dell hard by the Wissahickon—to commingle again, with its own—in a valley the doctor had always loved.

And the vale of the Wissahickon is glorified through his dust—even, as in life, his fertile impress was left upon every field wherein he labored. God bless his memory.

IVOR GRIFFITH.

THE LEFFMANN MEMORIAL MEETING

On Friday afternoon, at the Wagner Free Institute of Science, where Dr. Leffmann had been a diligent worker for many decades, a large group of his friends and admirers gathered together to pay their tribute to the memory of this beloved Philadelphia citizen and scientist. From all walks of life they came, chemists, engineers, pharmacists, physicians, educators, literateurs—nor do we wonder at the diversity, for the good doctor, in life, had been an understanding friend to them all.

Dr. Wilmer Krusen, President of the Philadelphia College of Pharmacy and Science, occupied the chair and after a brief statement of the purpose of the meeting introduced the several speakers who had come as representatives of various institutions and organizations.

Dr. Max Trumper, formerly associated with Dr. Leffmann, exhibited a film showing the doctor at work in his laboratory. After this, memorial addresses were delivered as follows:

Dr. S. Solis-Cohen, Representing the Medical Profession; Dr. Howard McClenahan, Secretary, Franklin Institute; Mr. Samuel T. Wagner, President of the Wagner Free Institute of Science; Dr. Philip Maas, Central High School; Dr. Charles H. LaWall, Dean of the Philadelphia College of Pharmacy and Science; Dr. Martha Tracy, Dean of The Woman's Medical College; Mr. S. Burns Weston, Ethical Culture Society; Mr. S. Swaab, President Engineers' Club. of Philadelphia.

These addresses are published herewith and exemplify all through the high regard in which Dr. Leffmann lived in the hearts of his fellow scientists.

IN BEHALF OF THE PHYSICIANS OF PHILADELPHIA

By Dr. S. Solis-Cohen

Once in a while one meets with men or women to whom may aptly be applied the Biblical phrase that they are "the salt of the earth." All who knew Henry Leffmann will agree that it is fitting and right to include him in the number of these choice spirits.

Although a graduate of Jefferson Medical College, and having the degree of Doctor of Medicine, Henry Leffmann was never a practitioner of the healing art. Nevertheless, the designation physician may rightly be used in speaking of him.

It was not only his keen interest in every branch of medical science and his mastery in the field of chemistry as applied to medicine, that warrant this designation, but a large portion of his work was in fields directly connected with the health problems of the community and of the individual. While it cannot be said that he ignored in his studies, the question of cure, or, as he would have preferred to say, of treatment, it is true that he gave immeasurably greater attention to those measures which render treatment unnecessary because they prevent disease. In an outline autobiography which he published in 1905, and which represented 44 years of his work, we find that he then held among others, the following positions:

> Professor of Chemistry in the Wagner Free Institute of Science;
>
> Professor of Chemistry, Toxicology and Hygiene in the Woman's Medical College of Pennsylvania;
>
> Emeritus Professor of Chemistry and Metallurgy in the Pennsylvania College of Dental Surgery;
>
> Emeritus Professor of Clinical Chemistry and Hygiene in the Philadelphia Polyclinic and College for Graduates in Medicine;
>
> Member of the Advisory Board, Department of Public Health and Charities, Philadelphia;

and that among the societies in which he held membership were The Society of Public Analysts of Great Britain, The American Academy of Medicine, The College of Physicians of Philadelphia, the Philadelphia County Medical Society, the Medical Jurisprudence Society, and the Biological and Microscopical Section of the National Academy of Sciences.

He was Port Physician of Philadelphia from 1884 to 1887, and again, in 1891 and 1892. And with him, at least, the office was no sinecure. Early in the morning he would be upon the river, and would remain late at night, when it was necessary or desirable. And he did his work thoroughly—not casually and perfunctorily. As in all other relations of life, he recognized his responsibility alike to the citizens of Philadelphia, to guard them against the importation of infection, to the men who went down to the sea in ships, whether crews or passengers, and to the business interests that could be affected by his official actions.

To the Biographical record of which I have spoken, there is appended a list of his contributions to literature up to that time, numbering in all, 250. Among these is one entitled "Under the Yellow Flag" printed in 1896; No. 250 upon the list of his contributions is one in which I take a special pride, since it was written at my request, as a contribution to "The System of Physiologic Therapeutics" which I edited. Its subject is "Civic Hygiene." Its length is a little less than 50 pages, but it covers its ground thoroughly. It containing among other things recommendations concerning the safeguarding of water supplies, and the disposal of waste, which are in some respects, in advance of anything yet put into operation. It advocates a sufficiency of open spaces and recreation grounds, regulation of the heights of buildings and the width of streets, calls attention to the necessity of roof gardens on school houses, as well as on public buildings, apartment houses and private residences in neighborhoods where adequate yard space for play and for beauty could not be obtained.

Among the other papers listed, are ten dealing with medical education and medical ethics; two upon expert testimony, several upon public water supplies, typhoid fever, food adulteration, milk inspection and milk standards, alcoholic excess, food preservatives, adulteration of wines and liquors, arsenic in kindergarten papers, and various aspects of urinalysis and other procedures in the clinical diagnostic laboratory. The list of writings thus intimately connected with the science and art of medicine could be greatly extended, but those I have cited may stand as illustrating the author's wide, but, in a measure, specialized, medical interests.

It is not upon such contributions, however, important and useful as they were in their time, and however much of permanent interest and importance they contain, that Henry Leffmann's chief claim

to the title of physician, rests. He was, if I may use the term, a physician to the profession; not that he treated the physical ills of doctors,—for he did not,—but that he observed, diagnosticated and helped to remedy threatening ills and constitutional defects in the structure and function of the American Medical profession as a collective, or organized body.

I have already alluded to the papers in which he analyzed the status of medical education, criticized its methods, pointed out their defects, and suggested means of overcoming them. With Dr. John Roberts, among others, he was largely instrumental in bringing about the establishment of a board of medical examiners in Pennsylvania, and in the gradual elevation of the standards for entrance into medical colleges and for admission into practice. I do not mean to intimate that the legislation contained in the first medical practice act, or its numerous amendments, met with his full approval. I merely cite this in illustration of one phase of his activities. Another advance that he and Dr. Roberts did much to bring about was the admission of women into the County Medical Society. To those who do not know of the controversies aroused by this proposition, it may seem a small matter; but it was a movement for justice which entailed earnest and untiring effort, before it was brought to a successful conclusion.

In a talk I had with Dr. Leffmann only a few weeks before his death, he recalled some instances of that struggle, in which I had shared as one of his junior lieutenants, and then sadly confessed his disappointment at the small bulk of the contributions that women physicians had made to the scientific work of the Society, seeking even then to find out what was the obstacle to a greater participation in the Society's most important work by the feminine element, and wondering whether the fact that they were not elected to important offices, acted as a deterrent—and why they should not be chosen. Dr. Leffmann also advocated the admission into the County Medical and other societies of Homeopathists and all others legally qualified to practice medicine in the State of Pennsylvania. To a limited extent, the ban has been lifted in the County Society, and there is greater fraternization among individual members of the so-called schools of medicine; but the union of all earnest, trained students of medical problems, without artificial distinction of cult and dogma, seems to be still in the future.

One might proceed indefinitely enumerating the items of Henry Leffmann's scientific and humane labors, and yet the thread that binds them together into a significant life achievement, not be made apparent, so long as attention is confined to the mere fact of his having written this, or done that. When we regard his career as a whole—and not his medical or scientific career only but his varied activities in literature, in politics, in economics, in everything that can be subsumed under the head of human relations—that thread becomes evident. He had a dual heredity, of which I was about to say he was proud, but pride was never one of his failings—let us say neither of which he was deliberately conscious and to which he occasionally referred. On his father's side, he said, he was partly Jew; and on his mother's side he was partly Quaker. Both strains were shown in his attitude toward science and toward life. He had one object, that which in science we call the search for truth; that which in morals we call the search for right. Truth and right, one principle in two aspects this was—these were his inspiration and his power. He was kind beyond measure, to young men entering the profession of medicine, but in the more personal feature of his intercourse with them, there mingled with this kindness a quality of abstract sternness. He condemned unsparingly, not individuals, but acts and motives, that seemed to him departures from the straight line of truth and right. He hated sham and pretence of all kinds; he would have nothing to do with chicanery; he went so far, at one time, as to ask the Governor of Pennsylvania to veto an appropriation bill granting a subsidy to an institution in which he was deeply interested, because he had heard of improper management of the act in the legislature; but the Governor said to him: "The institution is worthy and no wrong attaches to those who truly represent it. I shall sign the bill and you and your colleagues can disregard any improper promises that may have been made." I cite this merely to show his exigent standard of right conduct in public, as well as in private affairs.

It was my own good fortune to come in contact with Henry Leffmann early in life, when I was a pupil of the Central High School. Our Professor of Chemistry derived his knowledge from antiquated text-books, and he taught us the obsolete nomenclature. One day he was absent, and a young, earnest substitute took his classes. I do not recall how it came about; nothing was said in the way of a reflection upon the absent professor. But at the conclusion of the hour,

the boys—at least those who were interested—knew that the theory of the combination of an acid with the oxide of a base was no longer held; that bicarbonate of soda had become sodium bicarbonate; and that by reason of certain developments in the theories of atoms and molecules, water was no longer HO, but H_2O. The acquaintance that Dr. Leffmann permitted me to form with him, when after the lecture hour I had gone up to him with certain questions that his new method of exposition had suggested, continued to the day of his death. When I entered my brother's office to study medicine, Dr. Leffmann permitted me to come into his laboratory for work in clinical chemistry. When I entered the County Medical Society, Dr. Leffmann was its Recording and Reporting Secretary. He wished to unburden himself of the duties of reporting and invited me to become his assistant, and later nominated me as his successor. It was from his mouth that, when I was still young in the profession, I received an invitation to become a member of the Polyclinic Faculty. And I recite these facts, not in a spirit of egotism, but merely to illustrate the manner in which he tried to help his juniors by giving them opportunities for development in research, in public affairs, in teaching, or in whatever field their apparent qualifications might lie. Restricted to a brief sketch in a limited field I have but inadequately pictured our friend and his work. But no account, however elaborate, no words, however eloquent, could be adequate. High-souled, magnanimous, tender-hearted, rejoicing in the success of his pupils more than in his own, this gallant gentleman, this devoted student, this leader in the path of right doing has left an enduring impress upon the life of his profession and of his city—an ineffaceable memory in the hearts that knew and loved him.

IN BEHALF OF THE FRANKLIN INSTITUTE

By Dr. Howard McClenahan, Secretary of the Institute

As the representative of The Franklin Institute, I deem it a privilege to attempt to express the grateful appreciation of that Institute for Dr. Henry Leffmann's association with it and of his invaluable services to it, and to express also the admiration and affection which the members of The Franklin Institute knew for Dr. Leffmann as a discriminating and productive scholar and, especially, as a man who in spite of unusual gifts and attainments, remained always approachable and stimulating and "who loved to do mercy and to help his fellow men!"

Dr. Leffmann joined The Franklin Institute twelve days after the present speaker was born, and remained to his death a support and an ornament to that old society. During fifty-eight years he has aided in the operations of the Institute as an influential member of the Committee on Science and the Arts, having control of the awards of the several medals possessed by the Institute, and as one of the Committee on Library, entrusted with the government of the reading room and library. During the period of his scientific activities he published in the *Journal of The Franklin Institute* twenty articles on such widely distributed subjects as photography, photographic chemistry, water purification, diamond mining, digestive ferments, water supply of ancient Jerusalem, and the diatoms of Agar-Agar. In 1913, the first book review by Dr. Leffmann appeared in the *Journal*. Since that time he has written literally hundreds of reviews upon the most varied subjects. He has not hesitated to show up the ignorance or the pretense of those whose writings were under criticism. He has been acid when acidity was called forth by the charlatanism, or the arrogance, of the works considered. He was a little impatient of stupidity, and did not regard the unfortunate possession of that quality as a necessary excuse for slovenliness of expression, or for the publication of articles of little merit. But he always strove for justice, he sought fairness and he combined humor and good-nature in his condemnation of error at the same time that he knew sympathy for the errant. These characteristics were so recognized by authors that a favorable review bearing the initials "H. L." came to be looked upon as a great desideratum.

In May, 1930, The Franklin Institute honored itself by electing Dr. Leffmann to honorary membership, *honoris causa*. I had the

pleasure of presenting him for the honor, "in recognition of valuable services to science in research, in teaching, as former Port Physician of the City of Philadelphia and as a discriminating but good-tempered critic." And I had a full recompense for all trouble taken in the merry twinkle of the eye and the audible chuckle of Dr. Leffmann as he murmured, "Yes, a discriminating but good-tempered critic!!"

As an investigator, administrator and teacher, Dr. Leffmann's interest seem to have been limited only by the boundaries of human knowledge. His writings covered the fields of language, history, philosophy, politics, human welfare, hygiene, food-adulteration, and pedagogy as well as the many technical phases of the physical and biological sciences. Whatever the subject of the moment's consideration, it was treated with a breadth of knowledge and a refinement of taste which characterized all of Dr. Leffmann's writings to an unusual degree. There seems to be no complete list of his published papers but there is competent evidence to show that, in addition to the book reviews mentioned above, these papers exceeded five hundred in number. They displayed a surprising breadth of knowledge, combined with reliable accuracy of detail. They showed an unfailing courage and singleness of purpose. And they were permeated with a gentleness of humor which must have made criticism less unpalatable, and have prevented rancor.

Others will speak with greater competence than I of Dr. Leffmann's helpfulness to his associates and assistants. There had been no opportunity for me to observe him in relationship to others who were his assistants or associates in active investigations. When the privilege of association with him came, he had already passed far beyond the Psalmist's limitation of "threescore years and ten." The gentleness of advancing years had come to him but with none of the evidences of age which often are distressing. Struck at once by the breadth of his knowledge and by the moderation of his judgment, I found him a sage advisor and a helpful friend. His friendly advice based upon his knowledge of things biological more than once deterred me, as Secretary of the Institute, from venturing into the, to me, strange world of biology. Time has confirmed his uttered judgments and has ever increased the measure of gratitude I feel towards him for his guidance.

I can speak with full knowledge of the nicety of feeling which he expressed, and of the consideration for the sensibilities and opinions of others always manifested by this great scholar. We all knew

of his encyclopedic and accurate memory and did not hesitate to substitute a query addressed to him for a search in a work of reference. How much better was an answer enlivened by Dr. Leffmann's wit than any quotation from any product of the printer's art!

We all enjoyed the ebullitions of his quaint, quizzical humor and found it a joyous victory to be able to tell him a new story. We admired the simplicity and courage of the man. Life for all of us in The Franklin Institute was enriched and made happier by the privilege of association with this courteous gentleman, this erudite but stimulating scholar, this "Happy Warrior" in the world's combat against ignorance and prejudice.

If it were my privilege to write an epitaph to Dr. Leffmann dead, as it would have been a pleasure to pen a eulogy of him living, it would be as follows:

"Here lies a man, brave, simple, true
Where'er he went, high aspirations grew;
He's gone beyond, to play a nobler part,
The love of truth and knowledge filling all his heart."

IN BEHALF OF THE WAGNER FREE INSTITUTE OF SCIENCE

By Samuel T. Wagner, President of the Institute

It was in December, 1892, that I first met Dr. Henry Leffmann. It was at a dinner given by the President of the Wagner Free Institute of Science to the Faculty of that Institution, to which I had just been elected.

Of the Faculty members at that time there are now but two survivors, Dr. William B. Scott and the speaker. Dr. J. T. Rothrock, Dr. Robert Ellis Thompson, Prof. S. T. Skidmore, and now Dr. Henry Leffmann have passed beyond.

Dr. Leffmann was the President of the Faculty at that time.

His connection with the Wagner Free Institute of Science began in 1874 when he delivered lectures on Botany. He continued as a Lecturer until 1885 when he was elected Professor of Chemistry. He continued as an active Professor until 1903 when he retired from the chair and was elected Honorary Professor of Chemistry. His withdrawal from active teaching did not mean the withdrawal of his interest in the work. It continued until his death.

The Wagner Free Institute of Science conferred the Honorary Degree of Ph. D. on him in 1874.

He was a member of the Board of Trustees from 1903 until his death, serving as Chairman of the Board from 1914 until 1926! His interests during that time were specially directed to the educational and publication work in which the Institute is engaged. We probably never had, or are likely to have one whose interest in science and the humanities were so great.

While a Trustee of the Institute, he, together with Mr. Samuel Wagner, President Emeritus, founded the Department of Chemistry Endowment Fund, for research in Chemistry. He followed its operations with the greatest interest.

Immediately after the death of his wife, he established the "Fannie Frank Leffmann Memorial Lectureship" for scientific lectures and American Colonial History.

It so happened that I was the first to tell him of his election as an Honorary Member of the Franklin Institute. Never shall I forget the pleasure with which he received this news. The sad part of it was that his wife had just died and he was unable to tell her.

One of the minor details of the man was his constant effort to begin meetings on time. He was generally unhappy if we were but a minute or so late. I have always honored him for it.

From close personal association with Dr. Henry Leffmann for nearly 40 years comes a feeling of the greatest personal loss. It was a rare privilege to have been associated with him and to lean on him for his wonderful store of information of all kinds. Everyone who has known him closely will have the same feeling.

I have purposely refrained from speaking on any other angle of Dr. Leffmann's career except his connection with the Wagner Free Institute of Science.

I feel that when I say that Dr. Henry Leffmann was a great man, there will be few who will disagree with me.

IN BEHALF OF THE CENTRAL HIGH SCHOOL OF PHILADELPHIA

By Dr. Philip Maas

Due to the unavoidable absence of Dr. John L. Haney, President of the Faculty of the Central High School, I have been deputized to represent Dr. Leffmann's earliest Alma Mater, at these memorial services.

Henry Leffmann came to our school in July, 1861, from the Madison Grammar School. He completed the four-year curriculum at the Central High School, but due to illness at the close of the fourth year, he was unable to attend the then required final examinations, and consequently was not awarded the diploma of the institution. However, a little later the degree of Master of Arts, honoris causa, was conferred upon him as of 1865.

Even in those early years Henry Leffmann showed his interest in things scientific, and during the interval between 1864 and 1865 he was given the position of laboratory pupil assistant to the professor of chemistry. In 1864 Dr. Rand resigned the professorship and was succeeded by Mr. Lemuel Stephens. Upon Mr. Stephens' retirement Dr. Isaac Norris was elected to fill the vacancy. Then in 1870 Dr. Elihu Thompson was made the assistant professor of chemistry. Dr. Morris resigned in 1876 and Dr. Thompson was elevated to the professorship. The vacancy thus caused by the promotion of Dr. Thompson was filled by the appointment of Henry Leffmann as assistant professor of chemistry. Both Dr. Leffmann and Dr. Thompson resigned in 1880 and were succeeded by the late Dr. William Houston Greene.

From 1877 until 1879 Henry Leffmann also taught chemistry in the Artisan's Night School. This school housed in the Central High School building, offered instruction for adults along various branches of learning. It was under the direction and the administration of the Philadelphia Board of Public Education and was the only public evening school at that time; being the forerunner of the present system of schools conducted for adult education. It might be of interest to mention in passing that during this epoch Dr. Houston occupied the chair of Professor of Physics at Central High. Drs. Thompson and Houston eventually became the inventors of the Thompson-Houston system of electrical generators.

From the foregoing statements one can readily appreciate what a stimulating scientific environment young Leffmann had as a background.

Dr. Solis-Cohen has already indicated that up to 1906 Dr. Leffmann was the author of nearly three hundred papers, pamphlets and books. From this time until his death this number was augmented by more than two hundred publications. Among the earliest of his writings was an "Elements of Chemistry," issued in 1881 by E. H. Butler & Co. This book was followed a little later by a "Compend of Chemistry," published privately by himself. The latter up to 1906 had passed through five editions. More familiar, however, is his "The Examination of Water," released in 1889. It was written with the help of Mr. Beam and was known under the general designation of "Leffmann and Beam's Water Analysis." It was a valued and much appreciated pathfinder in a field which was little known and practically unexplored at that time. The book passed through a number of editions.

I was never intimately acquainted with Dr. Leffmann. My first contact with him occurred in my student days at the University of Pennsylvania. In the early days of 1894. I had been asked by Dr. Edgar Fahs Smith, of beloved memory, to analyze some mineral waters for Dr. Pepper, then Provost of the University of Pennsylvania. Dr. Pepper was interested in the probable therapeutic value of these waters, especially in regard to their lithia content. I remember poring over the Leffmann and Beam text and, when an opportunity offered, asking Dr. Leffmann some advice as to the best procedure to follow. As was customary with him he entered into the solution of the problem as if it were his own.

Another book which was also a pioneer in its field was "The Analysis of Milk and Milk Products," first published in 1893, by the Blackiston's. The foregoing decisively and definitely influenced the modern methods of food inspection and their preservation. Experiences gained along these lines made Dr. Leffmann an acknowledged authority upon such topics, and secured for him an editorship in the revision of volume two, part one, of "Allen's Commercial Organic Analysis." The first revision was made in 1889 and was followed later by others.

His geniality and general good humor is well exemplified in his autobiography. He divided his life up to 1906 into three epochs each of which is illustrated by a photograph of himself at the time,

and a characteristic verse. The first one is dated 1853 and is labelled the school boy age, with the quotation—"The school boy with his shining morning face." The second one is dated 1884, the young man period, to which is attached the couplet—"Bearded like the pard. Seeking the bubble reputation." The third period has the date 1902; the middle age, in which he credits himself with being—"Full of wise saws and modern instances."

Dr. Solis-Cohen has referred to Dr. Leffmann's almost uncanny ability to sense the salient points of a problem and to summarize the facts and arrive at a decision without delay. I remember an instance of this nature which aptly illustrates his method. After the publication of Hall Caine's—"The Woman Thou Gavest Me," a question was raised by some of the stockholders of the Mercantile Library as to the propriety of placing copies of this book upon the library shelves for general circulation. The objections became very insistent and were brought to a head at the next annual meeting of the stockholders. There was considerable random discussion and towards the close of the argumentation Dr. Leffmann arose and asked permission for the privilege of the floor. He pointed out that this story had already circulated among the patrons of the library; having been published serially in one of the magazines then on the library tables. Being assured by the librarian that he was citing true facts he stated that the library company would stultify itself and hold up the members to ridicule if they insisted that the book should not be listed. He made the matter so clear that the opposition collapsed and several copies of the book were placed in general circulation.

Again citing remarks made by Dr. Solis-Cohen upon Dr. Leffmann's wide range of knowledge upon many subjects, as well as his varied activities, I desire to add one more item. President Cleveland, in 1888, had appointed him Coiner at the Philadelphia Mint, but the appointment was not confirmed by Congress due to political jealousies among his Democratic backers. Later, however, he was made a member of the important Assay Commission of the United States.

In conclusion Mr. Chairman, Ladies and Gentlemen, I deem it an honor to have had the privilege of representing the Central High School at these Memorial Services for so distinguished a citizen as Dr. Henry Leffmann.

IN BEHALF OF THE PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE

By Charles H. LaWall, D. Sc., Ph. M., Dean of Pharmacy

My first meeting with Dr. Henry Leffmann was about 1892, while I was a student in pharmacy and many years before either Dr. Leffmann or myself were officially connected with the college. Dr. Leffmann at that time had his office and laboratory at 715 Walnut Street. It was on the third floor front, with no elevator, so in order to spare his clients and friends the trouble of walking upstairs unnecessarily he had arranged an ingenious system of strings and levers so that when he hung his hat on a peg near the window, a shingle which was attached to the window frame just outside the top of the upper sash, would stand out horizontally.

A prospective caller standing on the pavement outside the building, or even on the front steps, had but to look aloft before climbing the stairs. If it stood out at right angles to the window, the doctor's hat was on the peg and one might be sure of finding him in.

My earliest contact with this great man was made through a mutual friend who had an office on the second floor of this same building, and who had brought home to the boarding house, where we both resided, interesting tales of this unusual personality.

I shall never forget the kindly interest Dr. Leffmann took in the bashful student to whom he showed his laboratory and explained the use of certain forms of apparatus which were then strange to me.

Years passed before we met again. I had graduated and was then in charge of one of the manufacturing departments in the laboratory of Smith, Kline and French Co. A problem arose in which outside expert assistance was needed and Dr. Leffmann was selected as the consultant. This brought me into rather close association with him for several years. In the meantime, I had accepted an instructorship at the Philadelphia College of Pharmacy, and had retained my contact with the laboratory mentioned, in a part-time position.

At the close of a scientific meeting at the college one afternoon, in 1903, Dr. Leffmann and I walked down Tenth Street together. There was much newspaper publicity at the time in connection with food adulteration, which was then flagrantly carried on in the absence of Federal legislation.

As food analysis had been my hobby and my specialty, and had been the cause of the original contact with him as a consultant, I mentioned casually that consulting food chemists must be kept very busy. Dr. Leffmann at that time had the greatest reputation in America as a specialist in this field, and had written a valuable and widely used book upon the subject.

Dr. Leffmann then had no private laboratory as he was devoting his full time to the Woman's Medical College. He turned to me and said: "That is so! I am thinking of opening a laboratory again—would you like to go in with me,"

The acceptance of this generous offer led to a close daily association with Dr. Leffmann, who was then in what might be called the prime of life. After several years had passed and his junior associate was able to continue unaided, Dr. Leffmann withdrew, and for a period of more than ten years we met only at scientific meetings or at the Wagner Institute, where he had turned over part of his lecturing work to me.

In 1919, after I had become Dean of the Philadelphia College of Pharmacy and Science, at a casual meeting on the street, I asked him to be a guest at one of the monthly faculty meetings. He accepted and attended, and I still treasure with pride and satisfaction the letter which he wrote to me the next day, expressing his gratification at having been afforded an opportunity "to come once more into the company of those who are engaged in the fields in which my own life was so largely spent, which seems to renew my youth" as he put it.

The college immediately placed laboratory facilities at his disposal and gave him a place on the staff of lecturers.

From that time to this, winter and summer, rain or shine, Dr. Leffmann was an almost daily attendant at the college. Even when we moved to West Philadelphia, the extra and tiresome journey did not deter him, although we usually found somebody who was going his way with a car when it came time for him to leave in the afternoon.

His inspiring influence upon the faculty members with whom he came into closest contact can never be replaced. His numerous contributions to the AMERICAN JOURNAL OF PHARMACY in the shape of editorials, book reviews and original articles, attest his mental alertness and versatility to the very last.

A few years ago in another letter he said, "I find that I cannot stay away from the college. It has become part of my life, I have not in all my varied teaching life acquired so strong an attachment."

He was an encyclopedia of information in many and unrelated fields. He had a deep and abiding sympathy with all human learning. His conversation was always interesting, usually witty and frequently brilliant, for he could draw at will from a rich storehouse of quotations and amusing anecdotes to illustrate or emphasize a point in an argument. He had an especial liking for younger men and I know of at least two others besides myself whom he aided in establishing themselves in laboratory work, and there are a half dozen more whom he has taken in generously as co-workers and co-authors in connection with some specific chemical problem which attracted him.

We of the Faculty and Instructional Corps of the Philadelphia College of Pharmacy and Science mourn the loss of one, who in his sincerity, intellectual honesty, scientific interest and ability, and in that rare quality of personal greatness that made all love and respect him, can never be replaced.

IN BEHALF OF THE WOMAN'S MEDICAL COLLEGE

By Dr. Martha Tracy, Dean of the College

In behalf of the Woman's Medical College of Pennsylvania I feel it an honor to pay today our tribute to the memory of Dr. Leffmann. He was Professor of Chemistry at the College for twenty-eight years, from 1888 to 1916 and Emeritus Professor after his retirement from active work, and I have no hesitancy in saying that few if any of those ever associated with the institution are remembered with the universal respect and affection that are accorded to Dr. Leffmann.

I knew him first when I entered the medical school as a student in 1899, and in 1909 I was privileged to receive appointment as Instructor in Chemistry under him. The association with him during the following fifteen years constitutes one of the pleasantest experiences of my life.

There is no one here who does not know of his skill as a teacher in his technical field; but beyond that the amazing breadth of his knowledge in related fields, and in literature and philosophy made conversation with him an education, and a rare privilege.

His genial, friendly smile, his delightful sense of humor, his tolerant attitude toward all differences of opinion, and his wisdom and tact in the conduct of his department and in guiding students and assistants as we progressed through the problems of chemistry under his direction, I am sure no student of those years will ever forget. He continued always a friend to the student who had passed beyond his classroom and his colleagues on the Faculty valued highly his wise and practical attitude toward the problems under discussion.

His interest in the progress of the College was very warm and continuous. Indeed many years ago he established there a scholarship fund in memory of his mother, Sarah Ann Leffmann, and he has remembered the institution in one of the trust funds established in his will.

It is about a year ago that I last had conversation with him at the Wagner Institute and he expressed the greatest pleasure in hearing of the plans under way for the new buildings of the Woman's Medical College.

To many women physicians here in Philadelphia and scattered abroad through the world his friendship will long remain a beautiful memory.

IN BEHALF OF THE SOCIETY FOR ETHICAL CULTURE OF PHILADELPHIA

By S. Burns Weston, Director of the Society

Having had close personal acquaintance with Dr. Henry Leffmann for a quarter of a century or more, and as, for nearly that length of time he was an active member of the Ethical Society, I am very glad to have the opportunity to say a few words at this Memorial Meeting held in his honor.

From my very first conference with Dr. Leffmann, he impressed me as a man of great ability and high character. His wide knowledge, his keen wit, and genial personality were marked. The natural gifts of mind and heart shone out brightly. In addition to his professional and scholarly achievements, he deserves high honor for what he was as a man.

It is appropriate, on this memorial occasion, to recall briefly the active help in four different directions, which Dr. Leffmann gave to the Ethical Society during the past two to three decades. Of special value were the stimulating Sunday evening lectures he gave us from time to time. His first address, twenty-two years ago, was on "Charles Dickens' Solution of the Problem of Poverty." Some of the other subjects on which he spoke were: "Primitive Man and His Work"; "The Struggle of the Nations in the History of Civilization"; "The Suppression of Paganism and the Establishment of Christianity"; "The Bible and Evolution"; "The Garden of Eden"; "The Virgin Birth—A Historical and Biblical Study"; "The Truth About Evolution"; "Human Nature and the Bible"; "The Real Thomas Paine"; "An Appreciation of Morris Jastrow, Jr."

Every lecture Dr. Leffmann delivered before our Society was well worth publication and permanent preservation. Last year he promised to give a lecture this season, if his health would permit him to do so. Alas his physical condition made it impossible.

Another way in which Dr. Leffmann rendered very valuable service to the Ethical Society was in conducting a large Adult Sunday Morning Class for quite a number of years. He gave a long series of talks to the class on: "Psychological Questions of the Old and New Testament"; "The Book of Mark"; "The Book of Matthew"; "From Paul to Constantine."

He and Dr. Jastrow led the class on alternate Sundays for several years, Dr. Jastrow's subject being the Old Testament and Dr. Leffman's the New Testament. This fine instructive voluntary work was highly appreciated.

Still another way in which the Ethical Society benefited by Dr. Leffmann's virile personality, was the part he took for some years in the early summer and autumn rambles to numerous places of historic, scientific, and artistic interest. He served as a guide on various occasions and, you who knew him, know how illuminating and stimulating he could be in that capacity.

A further indication of Dr. Leffmann's real interest in the Ethical Society is, that he voluntarily and regularly made an annual contribution towards its maintenance, that he was the first one to contribute to the Building Fund which made possible the possession of our present Society House on Rittenhouse Square, and that three years ago he made a contribution to our permanent Endowment Fund, the income from which insures his continued support of the Ethical Society in all the years to come.

That Dr. Leffmann was at one time a member of our Board of Trustees should also be mentioned.

The facts I have cited make clear one aspect of Dr. Leffmann's many-sided humanitarian and highly intellectual life. He was the embodiment of a great scholar and a noble man.

We of the Ethical Society cannot fail to cherish the memory of what he was and what he did for us. In our minds and hearts will remain henceforth the honored name of Henry Leffmann.

IN BEHALF OF THE ENGINEERS' CLUB OF PHILADELPHIA

By S. M. Swaab, M. E.

If an ordinary mortal may, without being considered immodest or impertinent, endorse a consummate master, even as a "Cat may look at a King," I am here to pay my respects to the memory of my friend, Dr. Henry Leffmann, without attempting to be elaborately eulogistic or laudatory.

I believe I may say, without fear of contradiction, that Henry Leffmann was, in his day, the best all-around scientist in the City of Philadelphia, as well as the possessor of a larger fund of general information and a broader general knowledge of things than is possessed by any other man of my acquaintance. Above all, to express it in the language of an engineer, he had more common sense, to the square inch, than almost any other man I know. His knowledge included not alone the physical and biological sciences, but he delved into religion, philosophy, psychology and the occult as well. There is, in fact, scarcely any subject which could be mentioned in his presence with which he was totally unfamiliar, and with most subjects, particularly those which are uppermost in our minds, his familiarity was remarkable. This was, undoubtedly, due to his basic training in chemistry and physics which, after all, is the foundation on which all of the other sciences are built, but outside of and beyond this, he was a man of vision and, as such, a great dreamer and one who could see the analogy between things natural and man made as few others could see it, and above all, he was a man of great sympathy and a teacher in the truest sense of the word; his greatest pleasure being that of imparting to others in his own inimitable style, that which had cost him time and effort to acquire.

We who, as young men, had the opportunity of sitting at the feet of this great master and who accompanied him on his numerous rambles in and around our city, had the advantage of being under the eye of a very keen observer and a very patient and unassuming leader. To attempt to exhaust the achievements of this great man would be a prodigious task, but, undoubtedly, in teaching he surpassed all his other faculties. Primarily, he was a physician, but I have no knowledge that he ever practiced. His work as a Sanitary Chemist took him largely into the domain of water and milk, and

as a Public Health Officer he exhibited a considerable knowledge of communicable diseases.

He was an expert toxicologist and his knowledge of medical jurisprudence was justly acknowledged. He had some knowledge of the classical languages, and may I include Hebrew in this, and while I am not sure regarding his colloquial knowledge of modern European languages, still his knowledge of technical German and French was unique, as it included not alone the commonplace, but the highly scientific as well. He knew considerable of histological and systematic botany, of zoology, of mineralogy and geology, and, in fact, of all the natural sciences; the only subjects with which he was possibly unacquainted, or at least did not possess an outstanding knowledge, are music and the mathematical sciences. Regarding the former, I heard him, on an occasion many years ago, compare himself to General Grant who said that he knew two tunes—the one was "Yankee Doodle" and the other wasn't; but his training was so broad and his reading so wide and varied and tremendous in quantity that it did not admit of the ordinary bounds or confines of mathematics. This was before the days of Einstein when, to use an ordinary expression, "the sky was the limit."

Dr. Leffmann, among all his other attainments, was an engineer, even though he was not usually reckoned among this fraternity. He presented many papers of great interest to the Engineers' Club of this city, of which he was, at one time, president, and among them I recall his paper entitled "George Washington as an Engineer," which made an impress on those who heard him, and has a lasting place in the published Proceedings of the Society. His versatility was unbounded and was acknowledged by everyone with whom he came in contact. At one time we endeavored, at the Engineers' Club, to classify our members according to the character of the papers which they presented, each man being reckoned as a specialist in a particular line. It was one of the delights of Dr. Leffmann to recall that when they came to him, he having talked and written on so many different subjects, they were at a loss to classify him, and next to his name was written the word "nondescript," which, I may say, was written with the greatest of respect for the man's abilities and for want of a better word, simply meant that there was no one classification big enough to comprise all of his writings.

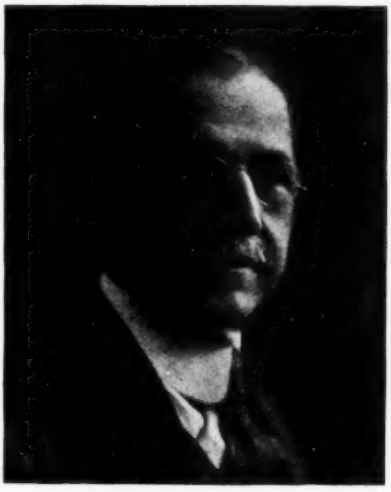
He had a rare sense of humor and was a raconteur without a peer.

In the death of Dr. Leffmann, Philadelphia has lost an outstanding citizen, and we who knew him intimately and loved him, an earnest and honest and charming friend and associate, a man who by the very prodigiousness of his learning, if I may use such an expression, and by his sterling character has endeared himself to each and every one of us to such an extent that his memory will long be revered among us, and his name a synonym for all that pertains to education, particularly when coupled with camaraderie and good fellowship.

OBITUARIES

JACOB S. BEETEM

JACOB SAMUEL BEETEM, Registrar of the Philadelphia College of Pharmacy and Science for nearly three decades, died at his home on Glen Mary Road, St. Davids, Pa., after a brief illness, on February 11, 1931.



Jacob S. Beetem.

Mr. Beetem was born at Carlisle, Pa., on October 5, 1856. He attended the public schools of Carlisle and graduated from the high school with honors in 1873. He was an apprentice in the pharmacy of Dr. George H. Markley, of Harrisburg, Pa., from 1873 until 1876. He then secured a position in Philadelphia with S. S. Bunting, Treasurer of the College, and later took up the pharmacy course at the College, from which he was graduated in 1878 as Ph. G. He was with Smith & Painter, Wilmington Del., for a short time, after which he again became associated with Mr. Bunting, with whom he remained until 1884, when he went back to Smith & Painter. In 1885 he secured an interest in the business and shortly after secured the entire retail business of the firm.

He was an organizer of the Delaware State Pharmaceutical Association and a delegate of that organization to the U. S. Pharmacopœial Conventions of 1890 and 1900.

In 1893 he opened a second store in Wilmington which he controlled for some time after selling his older store, which he did in 1894, when he accepted a position of confidential responsibility with John Wyeth & Brother, which he retained until 1896.

Mr. Beetem was deeply interested in the Alumni Association of the Philadelphia College of Pharmacy and Science. He was

corresponding secretary (1892-1893), second vice-president (1893-1894), first vice-president (1894-1895), and president (1895-1896).

In July, 1903, he sold his remaining store in Wilmington and in September of the same year accepted the position of Registrar at the College. He conscientiously and faithfully performed the duties of this important office for nearly thirty years and inaugurated many improvements in methods of handling the difficult and voluminous work which pertains to this position.

He was a member of the Masonic order, and also of the Pennsylvania Pharmaceutical Association, and was keenly interested in the growth and development of pharmaceutical education, particularly of the institution with which he was officially connected.

He is survived by his wife, two daughters, Mrs. Kathryn Rossborough and Eleanor, both of Philadelphia, and two grandchildren, Nyeth and Annabell Rossborough. He also is survived by a sister, Mrs. Bella M. Devine, a brother, Edward C. Beetem, both of Carlisle, and several nephews and nieces.

Jacob S. Beetem was a man among men. His high character, his unusual executive ability and his forceful personality, made a deep and lasting impression upon all those who came to know him, while his untiring devotion to his Alma Mater, as dear to him, almost, as life itself, won for him the affection and esteem of thousands of students of the Philadelphia College of Pharmacy and Science as well as others, who had business relations with the college.

J. W. ENGLAND.

WILLIAM E. JENKS

WILLIAM EARL JENKS, of John Wyeth & Bro., Inc., Eleventh Street and Washington Avenue, died on February 22, 1931, in the University Hospital, at the age of seventy, of heart disease.

He was connected with the Wyeth firm more than forty years, and also conducted a pharmacy at 4043 Market Street. He graduated from the Philadelphia College of Pharmacy in 1881; subject of thesis, *Iris Versicolor*. He is survived by two nieces and three nephews, Mrs. Carl A. Schlack, of the Stonehurst Court Apartments, Upper Darby, and Miss Lydia D., Richard L., William J. and Troutman Jenks, of 500 Lombardy Road, Drexel Park.

EDWARD V. HOWELL

EDWARD VERNON HOWELL, founder of the School of Pharmacy of the University of North Carolina, and its dean for thirty-three years, died at his home in Chapel Hill of pneumonia early in the evening of February 14th.

He had been severely ill for over two weeks, and his condition had been critical for several days, but unexpected rallies had led his relatives and friends to hope that he would recover.

No man was better known or better loved in Chapel Hill than Dean Howell. When he came to Chapel Hill it was a tiny remote village and the university had a student body of only about 400 and a faculty of about twenty-five. He saw the institution through all the stages of its growth, and carried his own school of pharmacy with it. He took an active part in the business and social life of the community.

Dean Howell's fame as a student and investigator in the science of pharmacy was nation-wide, and last year he received one of the highest honors that can be accorded to a pharmacist—the appointment to the revision committee of the United States Pharmacopœia.

Dean Howell was a renowned athlete, both at Wake Forest College and at the University. He was awarded a medal for the best all-around athlete at Wake Forest.

He was born in Raleigh, March 30, 1872, and twenty years afterward, 1892, received the degree of Bachelor of Arts from Wake Forest College. Two years later the Philadelphia College of Pharmacy awarded him the degree of Ph. G. He did post-graduate work in chemistry at the University of North Carolina in 1897-98, and since September, 1897, has been professor of pharmacy and dean of the department.

Some of the honors held by Dean Howell are: member of the American Pharmaceutical Association (chairman Historical Section 1918-19, vice-chairman Scientific Section); member of the American Chemical Society, the North Carolina Pharmaceutical Association, the American Historical Association, American Folk-Lore Society, Elisha Mitchell Scientific Society (president 1913-14), and the Sigma Alpha Epsilon fraternity. He was vice-president of the American Conference of Pharmaceutical Faculties in 1923-24, member of the executive committee of the American Association of Col-

leges of Pharmacy in 1926-27, and a contributor to various pharmaceutical journals.

The funeral services were conducted at his home in Chapel Hill on the afternoon of February 16th, and interment took place at four o'clock in Raleigh.

ORIGINAL ARTICLES

CASCARA

By T. J. Starker, Professor of Forestry, Oregon State College, and A. R. Wilcox, Forest Examiner, U. S. F. S.

(Continued from February Issue)

Collecting and Curing the Bark

The collecting season of cascara bark opens about the middle of April and closes about the end of August. The collection period depends of course, upon the season and locality. It is best that the tree be in full leaf before peeling begins; otherwise, the bark, as a rule, will not slip well. By far the largest amount of bark is collected back in the mountains, and is usually packed out by man or horse to the drying areas and breaking sheds. Such collecting entails considerable labor and expense before the bark is ready for shipment.

Various estimates are placed on the amount of money that a peeler can earn at this seasonal industry, which is followed by hundreds of people in the Pacific Northwest. Persons of all ages may be found working in the woods during this period, ranging from

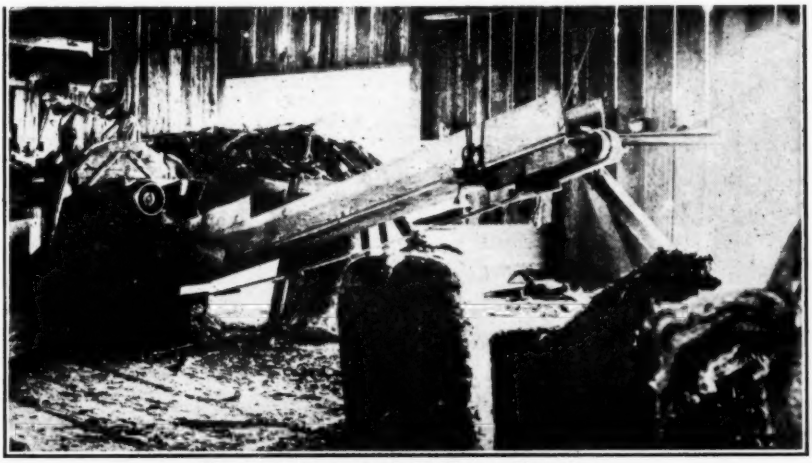


Fig. 11—A Power Bark Breaker in Operation.

twelve years up. Entire families go camping and work at this industry and thus happily combine an ideal outing with a revenue-producing sideline. The wage made will vary with the price paid per pound, the skill and industry of the peeler, the size and stand of trees, the distance from market and the season of the year which affects the ease of removal. The average adult will perhaps make $4 per day, while the expert could earn from two to three times as much. In a few exceptional case individual peelers have been known to make $20 to $30 per day.

Good peelers, under favorable conditions, can peel from 100 to 250 pounds of dry bark per day.

Bark should not be collected during rainy weather because drying is more difficult and staining or blackening often results. For this reason the excessive spring rainfall in the Puget Sound country makes collecting and curing difficult. Dark colored or stained bark commands a lower price because of these defects.

The bark is peeled in as large pieces or strips as possible and is then dried in the sun in this form. Curling of the bark results from drying. Cured bark should not be permitted to become wet as it will readily mold in this condition.

Often the bark is covered with moss and lichens. These should be removed because clean bark is more salable. Cleaning is best done by scraping with the spud before the bark is removed from the tree, or by "currying" the trunk and limbs with a gunnysack.

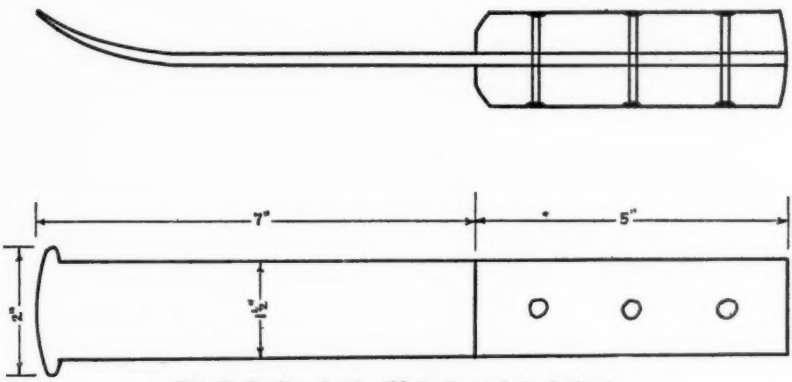


Fig. 12—Peeling Spud. (Made From Auto Spring.)

The implements usually used in collecting the bark are an axe and a spud of some sort. Many types of spuds have been devised by different collectors. These, however, vary little in size and detail and are often made from an old file or a leaf of a buggy or auto spring. Many spuds are made for both cutting and peeling, the use of a knife thus being eliminated. The axe is merely used for cutting down the trees.

Curing is best done in the open on a canvas or platform of some sort. In favorable weather the bark can be dried sufficiently for storing in about four days. In the drying process the inside of the bark should not be exposed to the sun because discoloration results.

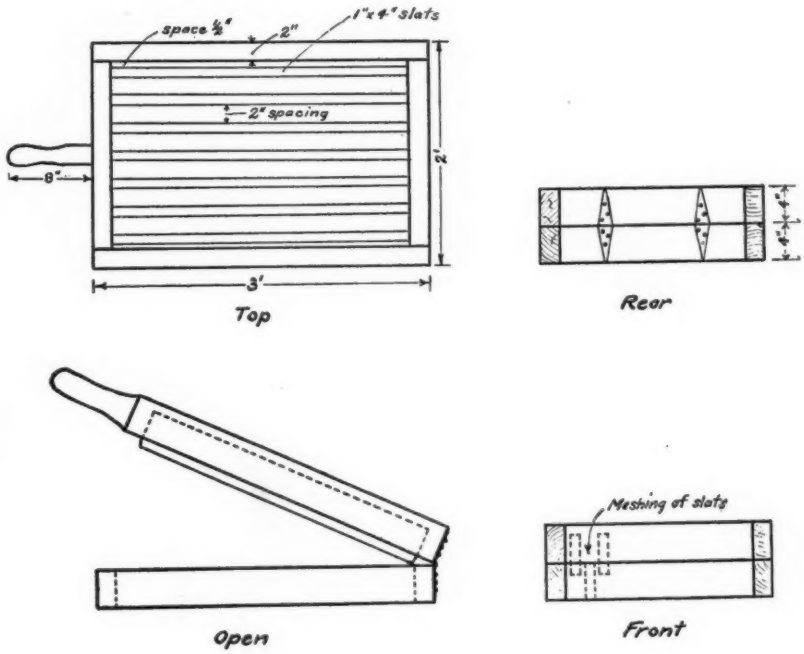


Fig. 13—Bark Breaking Machine.

Properly dried bark has a clear orange or golden yellow color and yields the highest chemical tests.

Several years are generally required after collection properly to age the bark[2] for medicinal purposes. The United States Pharmacopœia directs that it should not be used until at least one year after it has been gathered. Some crude-drug dealers undertake the "aging" of the bark themselves rather than leave it to collectors. This seems to be the general tendency at present.

After the peeling season is over the dried bark is broken into small pieces and sacked in ordinary burlap sacks for sale and shipment. From fifty to seventy-five pounds of dried bark can be put in a sack. Numerous methods are employed in the breaking up process. A hand-power feed cutter is perhaps the best and fastest machine for this purpose. Various other methods have been devised. One of the commoner machines is constructed chiefly of 1 x 4 lumber mounted on a heavier frame of 2 x 4s. (See Fig. 8.) Two similar sections are made with the 1 x 4s placed edgewise and parallel and spaced about one and one-half to two inches apart. The upper part is provided with a handle for raising and lowering, and the two sections are hinged together. The machine is so constructed that the upper and lower slats, 1 x 4s, mesh. The bark is placed in the open machine and the top portion is lowered with the aid of the handle. The bark, which is easily broken, falls through the slats. Large quantities may be broken by one man in a day, with the aid of this device. Another method is to place the bark in sacks and to break it up by flailing or trampling. On one collecting operation a hand corn sheller was used effectively for the breaking process.

Small boys[26] are engaged for this purpose, the bark being first placed in a big shallow box, where the youngsters alternately use their feet and hands in the operation. In passing, it may be said that the boys so employed can testify to the virtues of the crude drug; as through inhaling the dust they experience the same results as if dosed with any of the medical preparations made from cascara. On good authority it is said that the smoking of tobacco adulterated with chittim bark is an effective aid in overcoming constipation.

Pounds of Dry Bark per Tree

The amount of dry bark per tree will depend largely upon the form of the individual tree and the thoroughness with which the bark has been peeled from the tree. Open-grown trees of a given diameter will not yield as much bark as trees growing with other species. Forest-grown trees have a much longer bole. They also have heavier branches, although not as many of them, and will yield more bark than trees grown along fence rows or in the open. It is not desirable to peel small trees as the bark is quite thin and consequently lighter in weight.

The following table [23] shows the wide differences that prevail in estimating the yield of bark that may be secured from different sized trees. The second column data were secured by averaging the estimates of several disinterested men, each of whom had wide experience in peeling and handling bark. The third column is the opinion of two very experienced peelers. Their figures were not included in arriving at the other averages. Where it has been possible to check yield figures, the last column gives the closest results.

Estimated yield of *dry* bark per tree:

Diameter of tree at ground	Weight of bark Several estimates arranged	Two bark peelers estimate
3″	4#	5#
4	8	8
5	9	15
6	10	18
7	11	22.5
8	12	25
9	15	35
10	20	50
11	25	60
12	35	75
15	50	100
16	60	150
17	75	175

Moody cut a sixteen-inch tree and carefully peeled and weighed the bark. The green bark weighed 248 pounds which when dried resulted in 128 pounds or a little less than shown in the table for this sized tree.

When using the above tabulated statement, it must be remembered that it is based on the present standard of utilization, which is satisfied with taking only the most easily peeled, heavy bark. More careful utilization would probably yield an additional 25 per cent by weight and 50 per cent more of active principle for which the bark is valued. This increase in percentage of active principle is due to the use of the thinner bark which has a high proportion of the medicinal properties.

As indicated above by the single illustration green bark loses 50 per cent. of its weight when dried. This is borne out by numerous other tests on commercial operations. Bark, however, shrinks more than this if peeled very early in the spring. The average loss for early peeling is approximately 60 per cent. Therefore peeling later in the season is more desirable. The above figures indicate the small amount of bark the smaller trees yield in proportion to the large ones, showing that it would be much more profitable to permit the small trees to grow to greater maturity. Column 2 appears to be too light for forest-grown trees, from five to six inches in diameter, which have developed a greater height and longer bole.

G. P. McClanahan, Forest Ranger, Siuslaw National Forest, submits the following on yield of dry bark from various classes of trees:

Trees peeled on the south side of Elk Creek, Section 20, T. 14 S. R. 9 W., August 17, 1929.

Stump diameters are outside bark twelve inches above highest ground.

Thickness of bark is taken at stump and mid-height.

Length (tree height) is taken from top of stump to one and one-quarter inch diameter outside the bark in tops.

The trees are divided into three general classes, A, B and C.

Class A includes trees that are tall and slender with not more than one limb (besides the main stem) one and one-quarter inches at its base.

Class B are average trees with two or three limbs besides the main stem, one and one-quarter inches or larger at their base. These are usually the average trees.

Class C are trees having spreadout wide crowns of three or more limbs one and one-quarter inches or more at their base.

				Bark		Weight	
No.	Class	Stump	Height	Stump	Mid.	Green	Dry
1	B	5.9	19.3	⅛	1/16	10	4¾
2	A	6.8	27.0	⅛	1/16	17	7½
3	C	6.4	20.0	3/32	1/16	16	7¼
4	B	7.8	33.0	⅛	⅛	22½	10
5*	B	6.8	31.0	3/32	⅛	30½	14
6*	C	7.9	25.0	¼	⅛	31	16

*Bark was sticking and was difficult to peel.

Cascara Bark Volume Table

During bygone years trespass in peeling cascara on national forest lands has occasionally occurred. Often there was difficulty in determining, with justice and satisfaction, the amount of bark that had been so peeled, upon which to base demand for payment of damages. Usually the bark was not on hand, or it could not be segregated from that peeled from private lands, or that secured by legitimate purchase.

This difficulty finally brought about the evolution of a bark volume table by Forest Supervisor R. S. Shelley, of the Siuslaw Forest. After measuring the height, stump diameter, and average thickness of the bark of the tree peeled, by the use of this table, a fair approximation of the amount of bark removed could be determined.

The quantities shown in this table have been checked to some extent, with the actual weight of dry bark secured from certain trees, and have been found to agree within a reasonable degree of accuracy.

CASCARA (Rhamnus purshiana) BARK VOLUME TABLE—DRY WEIGHT*

Diam. Inches	10 ft. lbs.	15 ft. lbs.	20 ft. lbs.	25 ft. lbs.	30 ft. sq. ft.	30 ft. lbs.	35 ft. lbs.	40 ft. lbs.	45 ft. lbs.
2½	5.5	2.8			17.67				
3	2.2	3.4	4.5	5.7	19.64				
3½	2.8	4.2	5.6	7.0	21.60	8.4			
4	3.4	5.1	6.8	8.6	23.56	10.2			
4½	4.1	6.1	8.1	10.2	25.53	12.4			
5	4.8	7.1	9.5	12.0	27.49	14.3	16.5	19.1	21.1
5½	5.5	8.2	10.9	13.7	29.45	16.5	19.0	21.9	24.4
6	6.2	9.4	12.5	15.7	31.41	18.8	21.7	25.0	28.0
6½	7.0	10.6	14.2	17.7	33.38	21.2	24.6	28.4	31.6
7	7.8	12.0	15.9	19.8	35.34	23.8	27.7	31.6	35.3
7½	8.7	13.4	17.6	22.2	37.31	26.5	30.8	35.1	39.5
8	9.7	14.8	19.5	24.5	39.27	21.3	34.0	38.9	43.8
8½	10.7	16.1	21.4	26.8	41.23	32.2	37.5	42.9	48.2
9	11.7	17.6	23.4	29.5	43.20	35.0	40.9	46.7	52.5
9½	12.7	19.2	25.4	31.9	45.16	38.0	44.3	50.5	57.0
10	13.8	20.9	27.5	34.6	47.12	41.0	48.2	54.7	61.5
10½	14.9	22.6	29.7	37.5	49.09	44.4	52.0	59.0	66.4
11	16.0	24.3	32.0	41.3	51.05	47.8	56.1	63.6	71.5
11½	17.2	26.0	34.4	43.2	53.01	51.2	60.1	68.2	76.6
12	18.5	27.8	36.9	46.3	54.98	54.9	64.6	73.0	82.3
12½	19.8	29.7	39.5	49.5	56.94	58.5	69.0	78.0	88.1
13	21.1	31.6	42.1	52.8	58.91	62.5	73.5	83.2	94.1
13½	22.5	33.6	44.8	56.1	60.87	66.5	78.3	89.0	100.1
14	23.9	35.7	47.6	59.8	62.83	70.7	83.4	95.0	106.8
14½	25.3	37.9	50.5	63.2	64.80	75.8	88.5	101.1	113.7
15	26.8	40.1	53.8	67.1	66.76	79.7	93.6	107.5	120.3
15½	28.4	42.3	58.5	70.9	68.72	84.1	99.1	113.7	127.5
16	30.0	44.6	60.0	79.9	70.69	89.1	104.7	120.1	135.0
17	33.3	49.6	66.9	83.4	74.61	98.2	116.6	134.1	150.4
18	36.9	55.0	74.0	92.3	78.54	110.1	129.2	147.5	166.7
19	40.6	60.8	81.6	102.1	82.47	122.0	142.7	163.3	184.0
20	44.9	67.9	89.8	112.3	86.40	134.8	157.2	179.7	202.1

*This table is an adaptation of one prepared by Mr. R. S. Shelley, Supervisor of the Siuslaw National Forest. However, instead of showing pronounced increases in bark thickness for stated diameters, the data were curved, which gives a gradual increase with an increase in diameter. This resulted, with certain additions, in the above table. Bark thickness is assumed to be average thickness for the length of the section. The following bark thicknesses were used: ⅛ in. at 3½ in.; ¼ in. at 8½ in.; ⅜ in. at 14½ in., and ½ in. at 20 in.

The following explanation, accompanying Mr. Shelley's table, is also applicable to this one: "Specific gravity of cascara bark varies from .4 to .8, or from 24.96 lbs. to 49.92 lbs. per cu. ft. Table based on specific gravity of .6. For light corky bark deduct ⅓, for heavy bark add ⅓. Trees are assumed to be frustums of cones taken to a 2-inch top diameter. Heights and weights may be combined if desired. Proper allowance must be made for variations in form and for limbs. If bark is thicker or thinner than thicknesses shown in table, proper correction must be made. Column in center of table shows surface area in square feet and may be used with variations of specific gravity and thickness to determine weight of bark."

Safeguarding the Future Supply

Past Peeling Practices

In the past there has been little, if any, attempt toward conservation or regeneration of the stock of cascara other than the requirement in the sales contracts of the Forest Service, that the stumps of trees cut shall not exceed six inches in height and shall not be peeled, in order to establish the chance for regeneration by coppice.

On other than national forest lands, when the peeling is done, stumps are usually cut high and many trees are not cut down at all. As much bark is removed as can be reached readily, while the balance is wasted. If the upper branches are fairly large, they may be lopped and peeled, the debris remaining as it falls. One receives the impression, in examining such peeled areas, that there has been a ruthless disregard of every consideration which does not assist in gathering the bark in the easiest and shortest way. Apparently no thought whatever is given to the continued existence of the species. So far as the majority of peelers are concerned, the species may become extinct with that peeling. Such trees as remain are left solely because they have been missed by the peelers or are not profitable to peel.

Method of Peeling to Secure Future Supply

To date little consideration has been given to perpetuating the cascara bark industry. As has been brought out earlier in this paper, little is known regarding germinating capacity and viability of the seeds, rate of growth of seedlings and coppice, and the proper methods and time of year for peeling to secure good reproduction by sprouts.

Another phase of the subject that is still open for experimentation and investigation, is methods of peeling similar to those which are practiced in the gathering of cinchona bark. The cinchona tree is not cut down, but instead, vertical strips are peeled from the bole of the tree, leaving part of the bark undisturbed. The tree is then left to heal over the wound and put on new bark. At a later date this process is repeated. One cascara area was observed on which some experimental peeling along this line was done by the owner of the trees. All the bark except a strip from two to three inches in width was removed from the bole and the tree left in this condition. The result of this experiment was that the trees were reduced to a weak-

ened condition. Another area was observed where all the bark was removed from the bole of the standing trees. Seven trees were peeled in this manner in the summer of 1925, and five of the seven were still alive and apparently in a fair condition in the summer of 1926. All these trees were putting on a more or less complete covering of new bark. This is a remarkable case, but it still leaves the question whether or not the trees will continue to live.

The following method of harvesting has been suggested by the United States Department of Agriculture[11]: If the trees are properly pruned, a crop of bark may be harvested each year without killing the whole tree, as is done in collecting the bark from wild trees. At the time of transplanting, the trees are cut to a straight stem about a foot high, from which all except the four uppermost buds are removed. The branches which afterwards develop from these buds are later deprived of their lower side shoots, thus causing the tree to grow a head of four long, stout branches instead of a single trunk. When the trees are large enough to yield a crop of bark, the longest of the four branches is cut off early in the spring flush with the trunk and a new branch is allowed to grow in its place. This process may be repeated yearly, removing only the largest branches of each tree in any one season.

Supervisor Shelley reports on finding a few cascara trees that were peeled the year preceding, probably in July, and were putting on a new coat of bark. These trees were four to five inches in diameter. The peeling was accomplished by girdling at the base of the tree and at the base of the crown, four to five feet apart, then slitting and removing the bark entire.

Other methods may be developed in the future when commercial plantings will yield a profit. Experiments should be conducted now so that proper procedure may be followed without delay to planters.

The Industry

The cascara bark industry is at the present time laboring under two difficulties. First, a great portion of the accessible woods have been cut over and the men engaged in the industry must look to remoter districts for the supply. Every year it becomes necessary to go farther and farther back into the mountains to gather the bark. Second, the supply has been decidedly variable, changing excessively as stimulated by sudden fluctuations in price.

Careful estimates [24] base the annual cut in the coast ranges of Western Oregon, Washington, and Northern California at twenty-five hundred tons. Except for eight or ten carloads each season from California and B. C., the entire crop comes from Oregon and Washington. London, England, is the largest single purchaser of cascara, about eight hundred tons finding its way to this market and from there to other European cities. Germany is also a large consumer of the bark. The Parke-Davis Drug Company, of Detroit, Michigan, is the largest consumer of cascara bark in the United States.

The annual output of bark is dependent upon surplus, prices, coast labor conditions, and weather conditions. The following are estimated figures covering production since 1919 furnished by I. P. Callison & Sons:

1919	3,500	tons
1920	5,500	"
1921	2,500	"
1922	1,500	"
1923	1,000	"
*1924	6,000	"
1925	2,200	"
1926	1,300	"
1927	1,500	"
1928	1,860	"
1929	1,400	"
1930	2,300	"

*In 1924 the following firms were circularized: Blumauer, Frank, Drug Co., Portland, Ore.; Kahn Bros., Portland, Ore.; Daniel Frye, Salem; H. F. Norton & Co., Portland and Seattle; Heidner & Co., Tacoma; Portland Hide & Wool Co., Portland; Stewart & Holmes, Seattle; I. P. Callison & Sons, Aberdeen. Considering that these firms handle 85 per cent. of the peel, the total was 3665 tons.

By figuring the average price paid for the dry bark during the past few years at about eight cents per pound, it is seen that the industry brings to the people of the west coast a revenue that runs well into the thousands of dollars annually. Perpetuation of this industry seems, therefore, very desirable. Proper procedure should be taken to keep it from facing extinction as has been the case with some of our industries which have depended on natural resources.

Local dealers buy the bark from the peelers in their surrounding districts and sell to large concerns, which in turn sell to the large crude-drug dealers.

The following is a list of price ranges paid the peeler since 1912.[24] Data secured from the largest dealer on the coast.

Year	Price Range		
1913	3 - 4.75c	1922	5.0- 8.0
1914	2.5- 4.25	1923	10.0-16.0
1915	3 - 4.25	1924	9.0-13.0
1916	4 - 5.0	1925	7.0- 8.0
1917	6.5- 7.5	1926	6½- 9.0
1918	9.0-15.0	1927	7.0- 9.0
1919	10.0-12.0	1928	7.0- 8.0
1920	8.0- 9.0	1929	6.0- 8.0
1921	6.0- 7.0	1930	9.0- 4.0

It cannot be inferred that the price in any one season started at the low figure and ended at the high. In some cases this was true, but in others the exact reverse occurred. In other years it started low, went up and then came down again.

The annual carrying charges on bark are estimated to be about three cents per pound. These charges include rent for storage space, insurance, taxes, interest and shrinkage in weight of the stored bark. Shrinkage equals about 2 to 5 per cent for the first year depending on dryness when put in storage.

In the past there were numerous bark companies that hired men to do the peeling for them, but apparently these companies do not exist today. The bark companies of the past were even organized to the extent that they controlled the prices paid for the bark. The highest price ever paid was when the bark was first introduced to commerce. The value of the bark for medicinal purposes was recognized about that time, and peelers received as high as fifty and sixty cents a pound for it. These attractive prices induced men to enter the peeling industry; as a result the supply was much in excess of the demand and the price soon fell to a few cents per pound.

The following prices paid in Seattle from 1901 to 1912 were taken from Johnson & Hindman's report[17]:

Year	Price Paid
1901	5.5- 4.5 cents
1902	6.0- 4.75 "
1903	22.5-10.0 "
1904	17.0- 7.0 "
1905	7.0- 5.5 "
1906	11.0- 5.5 "
1907	10.5- 8.5 "
1908	9.5- 6.5 "
1909	8.5- 7.0 "
1910	7.5- 7.0 "
1911	9.0- 7.5 "
1912	10.5- 8.0 "

The prevailing prices on cascara bark in the New York market from 1914 to the first of the year 1925 were:

1914	.07-½ cents	1920	.14-.15 cents
1915	.07-½ "	1921	.15-.10 "
1916	.07 "	1922	.10-.12 "
1917	.11-.14 "	1923	.13-.25 "
1918	.14-.18 "	1924	.25-.15 "
1919	.19-.15 "		

The prices for 1925 were somewhat less, ranging from fourteen cents to fifteen cents. It must be taken into consideration, however, that prices on the coast would be quite a little lower than these, as the price mentioned in New York is usually for bark two years old or older.

Both the United States Forest Service and the Weyerhauser Timber Company sell bark under contract to peelers from their forests. Each contract specifies that the tree shall be cut down, leaving a short stump with a smooth surface, preferably not to exceed six inches in height, from which the bark shall not be peeled. The reason for this clause of the contract is to secure reproduction from coppice.

The first bark advertised by the United States Forest Service under contract to peelers was in 1919,[19] 20,000 pounds being advertised for sale at three cents and sold to the highest bidder for five and one-tenth cents per pound for the dried bark. Previous to this many small sales had been made at one cent per pound. The

industry has developed to considerable proportions on the Siuslaw National Forest in Oregon. The national forests in general, however, are not considered as much of a source of supply, for at present, only about 3 per cent. of the bark harvested comes from these timbered areas. The cut on the Siuslaw National Forest is seven times greater than on any other forest.

Without doubt the supply of bark is being rapidly depleted, for it is necessary to gather it from the remoter and more inaccessible areas to meet the increasing demands. Much of the original cascara acreage has been cleared for agricultural purposes, thus lessening the possibility of second growth. Areas are already being peeled over for the second and third time. This second and third peel is said to come from trees that were too small to yield heavy enough bark at previous cuttings. The trees that are peeled today are much smaller in the aggregate than trees peeled twenty to thirty years ago.

When stumps are left, they need light to develop good sprouts. This, in many cases, is lacking in the virgin forest where coniferous species are overtopping the cascara. In other words, under intense forest conditions cascara cannot compete when once cut out. The above conditions perhaps account for the lack of sprouts reported on the Siuslaw where the young Douglas fir has come up and overshadowed the slower growing hardwood. At the present rate of consumption, about 500,000 trees per year, according to Government statistics, are being peeled annually. The supply will apparently be exhausted in the near future, and it is doubtful if a substitute will be developed. Many inquiries are already being made by persons interested in the industry as to the advisability of raising cascara. With the meager data available on the growing of this tree, however, these questions cannot be answered satisfactorily.

Estimate of Existing Stand

As previously mentioned, cascara occurs as single trees or groups and occasionally as small pure groves. Even so, there appears to be nothing uniform in the regularity of its occurrence. One opening in the timber cover being well stocked, the next one a hundred yards away may have none. The same is true of various slopes and contiguous small drainages.

No instance is known where anything approaching an actual tally has been made of the cascara to be found on even a section or two of area, probably because its scattered occurrence would make

the cost of such an investigation prohibitive. Consequently any figure as to the amount of cascara bark still available for peeling must be based upon the experience of peelers and forest officers who are familiar with the yields of cascara in the regions where the tree is found.

Such an estimate has been secured from M. S. Durbin, forest ranger, who for eighteen years was in charge of the Waldport District of the Siuslaw Forest. A large proportion of the cascara sales of the forest were made in that district, during that time. While purely an estimate, it is the most trustworthy information available on which to base a calculation of the present stand of cascara on the Siuslaw and similar regions of Oregon and Washington.

ESTIMATE OF THE VOLUME OF CASCARA BARK TO BE FOUND IN CERTAIN DRAINAGE AREAS OF THE WALDPORT RANGER DISTRICT OF THE SIUSLAW NATIONAL FOREST

Drainage	Tp.-S.	R.-W.	Approximate Areas by Sections Total	Patented	Estimated Stand on Federal Lands Net	Tons
Buck Cr.	15	10	10	3.5	6.5	19–20
Cascade Cr.	14	10	6	.75	5.25	8–10
Cherry Cr.	14	9	2.5	.5	2.0	4– 5
Upper Yachats	15	10 & 11	7	2.5	4.5	14–15
Grass Cr.	14	10	6	.5	5.5	4– 6
School Cr.	15	10	2	.5	1.5	2– 3
Canal Cr.	14	10	11	2	9	13–15
Stump Cr.	15	11	4	2	2	2– 3
Lake Cr.	14	10	2	0	2	5– 6
Alseas Riv. N. side to Scott Cr.	13	10	13	3	10	5– 7
Alsea Riv. S. side to 5-Riv. East	14	9	4	1.5	2.5	6– 8
Totals	—	—	67.5	16.75	50.75	82.98

Average stand per government section 1.63 tons.

The above areas contain probably the heaviest stands of cascara in the Waldport district. The total district contains approximately 187 sections. The sections not included in the estimate are not nearly as heavily stocked, although cascara does occur, as single specimens or occasional groups.

The balance of the stand is estimated at fifty tons, making a total stand in the 187 sections for the district of 133 tons, or an average of seven-tenths of a ton per section.

The stand of cascara throughout its range, where found in commercial quantities, may be calculated from the same basis.

The cut of cascara from national forest lands from 1915 to 1924 should give an index to the regions in which the species occurs, in commercial quantities. A summary of the cut, as reported to the District Forester, at Portland, Oregon, is as follows:

Siuslaw National Forest	221 tons
Cascade National Forest	15 tons
Santiam National Forest	3 tons
Columbia National Forest	less than ¼ ton
Rainier National Forest	1 ton
Olympic National Forest	23 tons
Total	263 tons

From the same source, the following statement was obtained on the cut of cascara bark for the years 1924 to 1928 from the national forests of Oregon and Washington.

From 1903 to 1912 California exported from two and one-quarter tons to twenty-six tons annually. A total of 115 tons, averaging eleven and one-half tons annually. The quantity purchased in the home trade is not known.

British Columbia also has commercial stands of cascara throughout the eastern portion of Vancouver Island and east, including the lower Frazier River region.

Year	Forest	Amount in Pounds	Value
1924	Cascade	1,729	$46.35
	Santiam	4,000	200.00
	Siuslaw	66,772	3,363.12
	Olympic	9,082	181.64
	Rainier	617	18.51
1925	Siuslaw	20,412	1,035.41
1926	None		
1927	Siuslaw	2,210	110.50
1928	None		

Although the range of the species extends eastward into the Rocky Mountains, the trees are so small and occur so infrequently that the available peel therefrom is rather insignificant. Consequently only the region west of the Cascade Mountains is considered in the following estimate.

From the above figures it would seem that the species is found in greatest abundance in a strip varying from forty to sixty miles wide, following the coast from the Coquille River in Oregon to the Canadian boundary and possibly 150 miles beyond.

In this strip it is estimated only 75 per cent. of the area has any chance of producing cascara. The balance is farm land, cutover areas, water surface, ocean front, sand dunes and other unproductive areas.

The stand in the productive portion of this fully stocked area is calculated at the same rate per square mile as that determined for the Siuslaw tract, *i. e.*, seven-tenths ton per section.

An area of lesser growth occurs to the east of the one mentioned, or roughly, between the Cascade Mountains and the coast ranges and extending northward from near Eureka, California, nearly to the southern extremity of Alaska.

In this strip only 50 per cent. of the area is considered to have any cascara whatever. In the balance of the area the rate of stand is estimated at one-fourth of the rate of stand of the Siuslaw area. This average is 350 pounds per section.

The following table of stand is based on these assumptions:

ESTIMATED MERCHANTABLE STAND OF CASCARA BARK ON THE PACIFIC COAST

	California		Oregon		Washington		British Columbia	
	Full Stand	Partial Stand	Full Stand	Partial Stand	Full Stand	Partial Stand	Full Stand	Parial Stand
		75x220	40x200	65x250	60x120	65x250	20x150	20x280
Total Sq. Miles area	—	15000	8000	16000	7500	16000	3000	5600
Less 25% from full stands	—	—	2000	—	1900	—	800	—
Less 50% from partial stands	—	7500	—	8000	—	8000	—	2800
Stocked area in Sq. Miles		7500	6000	8000	5600	8000	2200	2800
Tons of bark on fully stocked lands at .7 ton per sec.	—	—	4200	—	3900	—	1500	—
Tons on partially stocked areas at ¼ of full stocking	—	1300	—	1400	—	1400	—	1000
Total merchantable tons of bark	1300		5600		5300		2500	
Grand total	15000 tons							

The above calculation is of value, of course, only in the absence of more concrete information. This table would indicate that at the present rate of production the available supply would only last about six years. However, there is a large quantity of small trees that become of peelable size each year, and which extend the production indefinitely.

It is generally conceded that the great bulk of the cascara producing area, in Oregon, at least, has been covered by peelers and the more accessible stands removed. The valley land of such areas has been put into cultivation or pasture lands in locations similar to the Willamette Valley so the future available sources will be in such restricted sites as fence rows, untilled lands, etc. With adequate seed supplies, such areas should furnish rather permanent sources of supply in the future. Stock of a size suitable for peeling would probably be fruiting for several years before it is large enough to cut, so future stands should be assured. The area so covered, however, can be only a fraction of that originally stocked.

In timbered, burned or cutover areas the restocking and development will depend upon a fairly open cover, source of seed and suitable soil drainage. Where this occurs in the open, the growth is much more vigorous than that which is shaded. Replacement by coppice is also much more common in such a location.

As logging continues, more and more area will be opened and become suitable for the natural growth of cascara. This will take place, of course, in proportion to the available seed supply. Its eventual development to peelable size will depend upon the degree to which the area becomes restocked to commercial timber species. For many years this restocking will probably be a matter of chance, as it is largely at the present time.

Eventually it is reasonable to suppose that the most economical use possible will be made of such land, which will mean artificial restocking to commercial species if a stand from natural sources is not forthcoming, with a consequent restriction of the area possible for the production of commercial stands of cascara.

Prospects of Future Stands

From 1925 to 1929 fully 25,000 acres within the Five Rivers and Yachats River watersheds of the Siuslaw National Forest were intensively examined in a timber survey. The various drainages in-

cluded in the previous estimate of stand are found in this locality. It lays in the heart of the region which has furnished a large portion of the peel of cascara from the Siuslaw Forest in years gone by. The stumps of peeled trees are frequently encountered. Very little of the area seems to have been too remote from transportation for peelers to operate. Occasional thickets are to be found containing a very few old growth trees that have not been peeled, but in general, the whole region has been quite completely covered. Such trees as remain appear to be only a fragmentary portion of the original stand. Some younger trees are found which were too small to peel when the main stand was removed.

Regeneration on the timbered portions of this area either from coppice or reproduction is negligible. Although many stumps were found, they were almost universally without living coppice. Nearly always the peeling of the tree was the end of the species in that spot. Much the same evidence is to be found on the national forest areas surrounding the patented lands. Certain national forest areas do remain, however, where the original stand is still intact, though such stands are the exception rather than the rule. Wherever regeneration is taking place in such manner as to presage a future peel, the stand of timber is thin or lacking and other conditions of soil, drainage, cover and seed supply favorable to regeneration are to be found.

Probably the main reason for the apparent lack of regeneration is the lessening of the area which is open enough and otherwise suitable for cascara growth. This limitation is caused by the complete shade of the surrounding young timber, which is now approximately seventy-five years of age. Areas that do not have a stand of coniferous timber are more or less completely stocked with alder, maple and brush, with which the cascara has been associated and with which it had an even chance for development in the years since the denuding fire of 1845. With a reopening of the forest cover, exposure of mineral soil, and presence of sufficient quantities of seed, regeneration of cascara on the former scale may reasonably be expected. It is believed that only where these conditions exist is satisfactory regeneration taking place.

The opening of the forest cover and exposure of the mineral soil is probably more complete as the result of forest fires than otherwise. But the restocking to evergreen species limits the area which has suitable light conditions for the production of cascara. Therefore it is found on the better drained bottom lands which are not

pre-empted by the previous stand of alder, maple and other lowland species, dense brush, etc. In areas suitable for timber production it may be found in proportion to the openness of the stand. Cascara that has been crowded by other species will be tall and have less branching of the main trunk than where grown in the open. The more shaded it is, the less freely it is likely to peel. Sometimes it can not be peeled at all.

Within national forest boundaries, the bottom lands and adjacent slopes within one mile, contain the most of the patented land. Consequently a much greater tonnage of cascara has been removed from private ownership than from government land.

The same degree of stocking occurred also through the thin stands and bottom lands of great areas of timber land not within the national forest boundaries. In the Willamette Valley the proportion of such areas suitable for cascara growth increases rapidly. In this region such soil and drainage conditions as are suitable for oak and ash favor cascara also. Large amounts of the bark have been secured from cover of this type, ever since the bark became of value, until this source is nearly exhausted. Cascara reproduction, however, is found along fences and in pastures, and various unimproved spots which are not disturbed from year to year.

Regeneration is much more promising as the proportion of light increases. Coppice is much more noticeable here than on the old cascara areas within the national forests. Young cascara is frequently found under such conditions also.

Alder is gradually encroaching from the canyon bottoms. But large areas of the uplands are covered with fern and brush. In this situation young cascara was found repeatedly, varying from the size of a pencil to two inches in diameter. It occurred as single trees, also in clumps and even as dense stands almost purely cascara. Some patches were two or three acres in extent.

This condition appears to agree with the evidence of what the early stands of cascara were like in the Siuslaw National Forest before it was limited and shaded out by the present heavy stand of young coniferous timber or alder growth. Therefore it is reasonable to suppose that the species will undergo much the same treatment from the encroaching cover that the Five Rivers stand has received in the past, with much the same results. That is, where soil, moisture and drainage are present and seeding has been secured, good stands will be produced. The stands that reach peelable size or the amount

of bark produced will very directly with the density of the associated cover. Inasmuch as the prospect of a complete stand of fir on the area is slight, and the cascara has an even chance with the alder, the chances are favorable for a mass production of the bark in that region in the future.

Artificial Propagation of Cascara

Reproduction

The cascara tree is a prolific seeder and the seed has a medium to low germination per cent. While germination is often tardy, the seed has a very persistent vitality.[12] Properly cared for, it retains its germinating qualities for at least two years. The seed should be stratified when first received or collected, unless it is planted just after picking. The pulp should be removed by soaking in warm water just before planting or stratification. Propagation from seed is easy. The seed should be planted in the fall soon after maturity or else it should be stratified in sand until used, since germination is very poor if it is allowed to become dry. It is not advisable to plant the seed in the spring because it has a tendency to lay dormant and not germinate until the next year. Neither is it advisable to bury the seed deeper than one-half inch when planting. One-quarter inch is preferable.

Mechanical germination tests of cascara seed by the Federal Seed Testing Bureau, show a very low germination per cent. For two lots of seed tested between damp blotters in a warm oven, the germination showed 6 and 2 per cent. respectively.

In earth tests in the open, the seed did not show a high rate of germination. This is also the finding of a commercial nurseryman near Tangent, Oregon, who planted a considerable quantity in the fall of 1924.

From results so far obtained, it is believed that fall sowing will give much better results than spring sowing. The results, however, are not conclusive and more experimentation on the best method to use in starting seedlings should be done.

In a series of germination experiments, where 100 seeds were each soaked in cold water, in hot water, in sulphuric acid, seed coat sanded, and where the green seed coats were retained when planted, little difference in the number of seedlings were noted, the averages being about 9 per cent.

Cuttings

Tests with cuttings indicate that best results are secured in a greenhouse with underneath heat. From tests made in the college greenhouses at least five months are required before the cuttings are ready for outdoor planting. Cuttings less than one-quarter inch in diameter and tips of shoots did not prove successful in callousing and developing roots. This is probably due to a lack of sufficient stored plant food.

Layers

Very strong plants may be obtained by layering. This is shown in Fig. 4, which illustrates results secured after one year in the nursery. In this method, lower limbs or sprouts are bent down to the ground and held there by a crotched stick or bent wire. Dirt is covered over the place of contact with the soil and the outer end is left free and uncovered. A slight injury by scraping of the covered portion assists in the formation of rootlets. Although this method gives good plants, it is more expensive than to secure wild stock, and should be used only if a few plants are desired.

Planting

Cascara under cultivation should do well and prove reasonably profitable if properly handled. Much care should be used in selecting the locations for plantations and attention should be given to the silvical habits of this species. Under proper management and site requirements a five-inch tree should result in fifteen years. As shown by the experience of expert peelers, this tree under present utilization standards would yield fifteen pounds of dry bark, or a pound a year for a fifteen-year rotation.

Davidson [20] recommends a spacing of two feet by three feet; Moody,[23] six feet by six feet, but in the experimental work done at the Oregon State College, a four by four planting was used. In order to expedite cultivation Miller planted his rows eight feet apart. Cascara needs side shade to develop a good, straight bole, free from limbs, and this condition is furnished in a pure, dense, even-aged stand, such as would be attained in a commercial planting spaced as above indicated. This spacing necessitates the use of 2722 trees per acre. And if the previous estimates were correct, would mean an annual yield of 2722 pounds of bark. This figure is perhaps maximum and could not always be secured in actual practice. Disease,

windthrow, loss of seedlings, fire and competition of other vegetation would probably reduce this figure by at least 50 per cent.

After a few years it will be necessary to remove some of the trees. Some trees grow faster than others, some will lag behind, others will become diseased. When these classes are removed periodically, they will afford a more or less continuous income, provided a large area is under management.

Trees cut and peeled will coppice and will provide future growth. It will probably be necessary from time to time to introduce seedlings into the plantation, as coppice growth eventually loses its vitality and runs out.

In view of the fact that the thinner bark yields a higher per cent. of active medicinal principle, based on weight, it may be possible and profitable in the future to grind up the smaller twigs and limbs for extraction. This process would permit of much closer utilization and should make the growing of the tree on a commercial basis more profitable. The idea of growing the cascara tree, as is now being done with our other commercially important forest trees, is not a new one, for experiments on a small scale along this line were conducted prior to 1905 by the United States Department of Agriculture near Washington, D. C. Cascara has been grown under cultivation at the Arnold Arboretum, near Cambridge, Mass., since 1873. The Kew Gardens in England raised cascara from the seed collected in California, and it has proved quite hardy. In 1914 experimental work of this nature was started at the Canadian Experimental Station of the Dominion Department of Agriculture at Sidney, on Vancouver Island. Unfortunately, the area which these trees occupied was needed for other purposes and the planting was destroyed before satisfactory data on its growth under cultivation could be obtained.

A demand for cascara seedlings has been created in the vicinity of the State College by people interested in the future of the industry. As a result, a nurseryman near Tangent, Oregon, planted a large amount of seed in the fall of 1925. At the end of four years these trees average fourteen feet tall and were two and one-half to three inches in diameter one foot from the ground. They grew very close in the row and the rows were four feet apart. The trees received six to eight cultivations per year. This nurseryman estimates that an acre of cascara planted on the proper location should return $1000 at the end of ten years. A large pulp company operating on the

lower Columbia River and at least one logging company have used cascara as well as alder, as hardwood fire breaks in their coniferous planting operations. The pulp company reports that they "did not lose a planted tree of cascara."

In 1926 Mr. Thomas Miller, of Route No. 1, Brownsville, Oregon, set out several hundred small, wild seedlings of cascara. Since then he has added to his plantation, until now he has some 6150 trees varying from three feet to fourteen feet tall. About 60 per cent. of the plantation is from transplanted wild stock and the balance from home grown seedlings. The land is good Willamette Valley farm land and intense cultivation has been practiced. The trees are set about two feet apart in the rows and eight feet between rows, and have shown fine growth except where the pruning was practiced too far up the stem. This led to a topheavy plant without sufficient strength to support the crown.

Mr. Miller expects to expand his plantation to about thirteen acres. At the end of ten years, he estimates the crop will return him between $1500 and $2000 per acre at present prices of bark.

At the School of Forestry Arboretum near Corvallis, Oregon, a small plantation of cascara was started in the fall of 1926. Several classes of stock were used; (a) some rather large trees dug in 1922 and transplanted in the nursery; (b) some small wild stock dug in the early spring of 1925 and grown a year in the nursery; (c) a very few layer plants. In addition to this, a small amount of seed was sown in some prepared seed spots. It is too early to give any definite data in regard to these plantings.

The development of these young seedlings under cultivation in the Willamette Valley should be observed. To date the little trees have been growing satisfactorily. There was some question in the past as to whether or not seedlings would stand transplanting. There are a few instances where this has not been successful, but the majority of the experiments show very satisfactory results. Experiments carried on at the Oregon State College Forest School have been very successful to date. Only a few of the very smallest seedlings which were brought in from the field as early as February, 1925, have failed to survive. Much larger wild seedlings, transplanted to the nursery in 1923, have put on very vigorous growth.

In 1919 the British Department of Forestry set out several test plantations of cascara in British East Africa near Nainwbi. To determine the rate of growth as affected by altitude they set out

several groups at different elevations, but in the same type of soil. The growth was vigorous, trees three years old producing berries and in 1926 the plants were from ten to fifteen feet in height. A sample extract was obtained in 1926, meeting all the standards for American bark, and producing no difference in action, so far as could be determined.

In 1926 a small plantation was made by G. F. Pederson of Waldport, Oregon. About an acre of cleared land, formerly pasture, was planted by plowing furrows eight feet apart and planting a seed about

The Author in the Thomas Miller Cascara Plantation Near Brownsville, Oregon. These Trees Have Received Proper Pruning.

every four feet. Later he also started some in nursery rows. Apparently these methods were not successful for a report on March 19, 1929, from Forest Ranger McClanahan, of Waldport, states that the most successful method Mr. Pederson had discovered was to plant the seed in a seed bed, as he found that only a small per cent. of the seed would germinate. Later they were transplanted to a fern hillside rather steep and well drained, with a southwest exposure and no shade. The soil is a sandy loam typical of that locality. The trees now average about twelve inches in height and are about sixty in number. They are all thrifty. The survival seems to be about 95 per cent.

Unfortunately the place has been sold and Mr. Pederson has moved to parts unknown, so the more precise details of the planting are not known.

A bulletin of the Department of Agriculture [11] states in part:

> "The trees have been found to grow better in clay loam than in either sand or clay. Propagation from seed is easy, but the seeds should be planted in the fall soon after they ripen or stratified in sand until used, since germination is very poor, if the seeds are allowed to become dry. The seeds are sown in a seed bed under shade in drills 8 inches apart and covered about one inch deep. The seedlings reach a height of 10 to 15 inches the first year and in the following spring, before the leaves appear, they are set in the field, six feet apart each way."

The profits to be derived from artificial propagation are problematical, of course. No figures are available as to the cost of securing the seed, planting and transplanting. The total cost for each acre planted would probably be at least $25, but probably less than $50.

From the estimate formerly given (p.) we may expect at least 1300 pounds of bark per acre, per year, from a plantation with a possibility of twice that much.

The price received for dry bark from 1920 to 1927, inclusive, varied from five cents to sixteen cents a pound, with an average of eight and one-half cents. Applying this to the annual yield of 1300 pounds per acre, the gross income therefrom, would vary from $65 to $208, with an average of $110.50.

Even with radically increased costs of establishing the plantations or some decrease in the amount of bark produced, there would still be a profit from the first harvest. Thereafter the profit should increase rapidly, as the stock would grow much more rapidly from

coppice than from seed. (See "Coppice," pages and .) Also there would be no nursery and planting charge against the second harvest, although there probably would be a light charge per acre for trimming out the coppice to a desirable stand. There is a possibility that the thinnings ground up would pay this expense.

With efficient care, management and investigation of methods to be employed in doing this work, the above figures of yield might well be expected. Because of the present uncertainty as to methods to be employed, and because of the long deferred first profits, few farmers, or small land owners, can be expected to make the first attempt for a long enough time and in areas large enough to be conclusive as to results.

The experiments by the Crown Willamette Pulp and Paper Company and the Long-Bell Lumber Company, previously mentioned, will be pertinent in this respect.

Theoretically, it appears that as great an annual profit per acre can be expected from this type of a forest crop as can be calculated in the growing of commercial timber from the seed. Therefore it would appear to be good business for the forest service to invest in such plantations and make the conclusive investigations necessary to place the artificial production of the bark on a commercial basis. After this has been accomplished and private enterprise sufficiently interested to maintain a future supply of bark, the government areas could once more be returned to their normal use of growing timber for the nation.

Summary

Information from all available sources indicates that the supply of cascara bark is being rapidly diminished. Exact information of cascara stands are unavailable. Even on national forest land no definite estimates have been secured. This is largely due to haphazard occurrence of cascara in the stand. Prospective peelers usually locate available areas and apply to the forest service for a sale rather than the forest service advertising that they have certain areas to be peeled. To locate the available stands would probably cost the government more than the revenue secured, and therefore this can only be done as an incidental in connection with other forest work. That such a condition now exists is evidenced by the facts

that collecting of the bark is now being done in the more remote and inaccessible regions, and that old areas have been repeeled two and three times. This cannot continue forever, and a shortage of the supply in the near future appears inevitable. To meet the demands for the bark, more conservative methods must be used in peeling, and the possibilities of growing cascara under cultivation should be considered. How the cascara tree will grow under cultivation, however, is known, and has been determined, only to a very limited extent.

In the last analysis, the matter of growing cascara will depend on whether we can make a profit. On the right sites the growing of this tree will probably bring in greater returns than commercial timber growing. This is due to the short rotation under which cascara can be grown and the probable increase in bark prices. This may be further augmented by some satisfactory utilization of the wood and the possibility of grinding the smaller twigs with their higher medicinal value.

It is fairly certain that the price of cascara bark will never rise to any high mark because of the competition of mineral compounds which will take its place as a laxative preparation in case its price becomes too high. As pointed out by Professor Powers, cascara is superior to other preparations, and since people are slow to change their custom in the use of any article, it is easy to believe that the bark of this tree will always command a reasonably high price.

Logging companies, the Crown-Willamette Pulp and Paper Company and the Long-Bell Company are experimenting with cascara as well as with other species in the making of natural fire breaks in their coniferous planting operations. It must be remembered that any other broadleaf tree will serve this purpose as well as cascara, and that the effectiveness of a narrow strip of hardwoods is still problematical in stopping a severe coniferous conflagration. As a filler in the coniferous forests of the Pacific northwest, cascara cannot prove otherwise than profitable. Most European practice points to the advisability and practicability of mixed forests. If cascara grows satisfactorily under these conditions, another useful end will be accomplishad and an added source of supply of bark will be assured.

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BOOK REVIEWS

DRUG STORE BUSINESS METHODS, 2d edition. A textbook of Commercial Pharmacy, by Charles W. Pearson, A. B., M. B. A.—298 pp. Cloth, $2.75. Lea & Febiger, Philadelphia, Pennsylvania.

There is no material change between this edition and the original which was published about four years ago.

The book is divided into five parts, treating with Salesmanship, Advertising, Accounting, Business Law and Store Management.

For the greater part, these subjects are all treated in a most general fashion, the author simply striking what might be considered as the high spots without elaborating or giving any detail of the subject.

As a text for present-day students of pharmacy, who should be given the greatest possible amount of training in up-to-date commercial methods, it seems entirely inadequate. It would better serve its purpose if at least one concrete example were given under each subject discussed, as it seems rather difficult to make pharmacists today realize that there is any connection between the theoretical considerations of salesmanship and merchandising and their individual drug store problems and needs. To the individual already beyond his student days, this same lack of completeness and specific illustrations would prevent the book from serving a most useful purpose.

On the other hand there is probably enough detail in the accounting section to save many a store where accounting methods are at present unknown.

A. B. N.

BIO-ASSAYS. James C. Munch. Williams & Wilkins Co., 1931.

Dr. Munch's important work on bio-assays contains the only comprehensive discussion of the subject, which has yet appeared in any language. All methods which have been proposed for such assays are given full consideration with complete references to the

work of those proposing them. More than five thousand published articles are quoted in the text and included in the very complete bibliographies which accompany each section. The book is divided into chapters dealing respectively with drugs affecting the nervous system, circulation, respiration and muscles, glandular products of animal origin, and special drugs, such as anthelmintics, cathartics and mydriatics. Each drug or group of drugs is treated in a special section arranged under subheadings according to the test animal, these being arranged in the order of biological development, beginning with unicellular organisms and leading up to man. Under each subheading the articles are arranged in chronologic order, showing the historical development of each method. When the author has had experience with a method, he states his own conclusions concerning it, otherwise he gives the opinions of those who have had such experience. At the end of each section he has reported his own experiments (many unpublished) and given his idea regarding the methods which appear most serviceable. If chemical assays are also in use, these are given due consideration and the relation between the results of chemical and of biologic assays is discussed.

The detail with which the subject is treated is indicated by the fact that digitalis and its allies require 165 pages, ergot 66 pages, epinephrine 32 pages. Other drugs receive equally adequate consideration. At the end of the book (pages 908 and 909) is a table giving the standards in cc. or mgm. per kilogram for 65 drugs as assayed by one or more of 15 typical methods. Assays of toxins and antitoxins and other bacterial products, which are fully discussed in other works devoted to these subjects, are merely touched upon.

The book is remarkably free from misprints for a work dealing so extensively with literature. The most serious one seen by the reviewer is on page 909 in the table mentioned, where the standard M. L. D. of bacterial toxins is headed L° DOSE and the standard L + dose is headed Lt DOSE.

Dr. Munch has not given the intimate details of carrying out the tests which one might have hoped for from a person of his wide experience. In those cases in which no test is official, the reader is forced to draw his own conclusions as to which the author considers the most suitable method, at least as regards details of operation, from his quotations and discussion of the work of other authors. While it is true that in the case of most drugs, the final word has not yet been spoken, the opinion of one with Dr. Munch's wide knowledge

of the subject would have been of the greatest value to all who are making such tests.

The book will be indispensable to all persons doing research work in biologic assays or in related fields, but its value to the routine worker would seem to be lessened by the absence of those detailed directions for carrying out the tests, which are so conspicuous a feature of smaller and more limited works dealing with the same subject.

T. G.